PHYSICS ABSTRACTS

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NOTE ON THE ARRANGEMENT OF ABSTRACTS

The Abstracts are classified by subject according to the Universal Decimal Classification, and arranged in order of their U.D.C. numbers. (An abridged version of the U.D.C. accompanies the Annual Index.) An abstract of interest under more than one head has additional U.D.C. numbers, linked by the colon sign, " : " e.g. " 536.21 : 548.0 Conduction of heat in crystals." The Abstract is printed once only, under the main number, e.g. in the section "HEAT 536," but Cross-references are inserted under the other numbers, e.g. " 548.0 : 536.21 *see Abstr.* 1234 " in the section " CRYSTALLOGRAPHY 548." These Cross-references should be investigated, therefore, when a particular section is being searched, as they contain additional matter relevant to that section. A Cross-reference does *not* refer to the Abstract which appears immediately above it.

Abstracts signed with the following initials have been supplied by the courtesy of the organizations named: "B.A." = British Abstracts. "E.R.A." = British Electrical and Allied Industries Research Association. "M.A." = Metallurgical Abstracts. " M.R." = Mathematical Reviews. " M-V." = Metropolitan-Vickers Electrical Co., Ltd. " P.O." = Post Office Engineering Department. "R.E.A." = Railway Engineering Abstracts.

MATHEMATICS 51

512.9 : 621.3.012.8 2212

Tensors and equivalent circuits. HOFFMANN, B. *J. Math. Phys.*, **25**, 21–5 (*Feb.*, 1946).—A criticism of two papers by Kron [Abstr. 1627 B (1944), 1193 B (1943)].

513.881 : 519.48 *see Abstr.* 2226

517.392 : 518.12 2213

Note on coefficients for numerical integration with differences. SALZER, H. E. *J. Math. Phys.*, **25**, 86–8 (*Feb.*, 1946).—It is shown that quantities tabulated in a previous note [Abstr. 2091 (1945)] may be used for continuous numerical integration using differences, in formulae obtained by integrating various interpolation formulae, e.g. that of Gregory and Newton. L. S. G.

517.512.2 : 548.73 : 621.3.018.3 : 518.5 *see Abstr.* 2223

517.512.4 : 621.3.015.3 : 621.392.5 2214

On transients in homogeneous ladder networks of finite length. NIJENHUIS, W. *Physica, 's Grav.*, **9**, 817–31 (*Sept.*, 1942).—[Abstr. 2123 B (1946)].

517.52 = 4 2215

Summation, by empirical representations, of slowly converging series arising in mathematical physics. VERNOTTE, P. *C.R. Acad. Sci., Paris*, **218**, 67–9 (*Jan.* 10, 1944) *In French.*—If the series is purely numerical, a successful method is to represent the general term empirically as a series in $n^{-\alpha}$. The remainder after n terms may then be calculated in terms of such remainders for the series $\sum n^{-\alpha}$, and the latter are well known. If the terms of the series depend on a variable x, e.g. $u_n = v_n f_n(x)$, this method is not suitable and the remainder, R_ν, after ν terms is developed into the form

$$R_\nu = \Phi_\nu(x)A(x)/\phi(\nu)$$

where $A(x) = F_0(x) + \nu^{-1}F_1(x) + \ldots + \nu^{-p}F_p(x)$, and Φ and ϕ depend on ν and the nature of the function f. An application is made to slowly converging trigonometric series of the form $u_n = v_n \sin nx$, and a numerical example is given. L. S. G.

517.544 = 393 2216

On the determinacy of the solutions of $\Delta^k u = 0$. BREMEKAMP, H. *Proc. Ned. Akad. Wet.*, **48**, 222–8 (1945) *In Dutch.*—A proof is given of a theorem stated by Sommerfeld (*Enzykl. d. Math. Wiss.*, **1**, 1): A function u is uniquely determinate inside a closed curve if in every point it satisfies the equation $\Delta^k u = 0$ and u, $\partial u/\partial n$, $\partial^2 u/\partial n^2 \ldots \partial^{k-1}u/\partial n^{k-1}$ have given boundary values. The proof is established by showing that $u = 0$ is the only function satisfying $\Delta^k u = 0$ with $u = \partial u/\partial n = \ldots = \partial^{k-1}u/\partial n^{k-1} = 0$ at the boundary. The theorem is extended and proved for the 3-dimensional case, and extension to n dimensions is possible. J. A. W.

517.544 = 393 2217

Properties of the solutions to $\Delta^k = 0$. BREMEKAMP, H. *Proc. Ned. Akad. Wet.*, **48**, 229–36 (1945) *In Dutch.*—If in a certain region $\Delta u = 0$, where Δ is the 2-dimensional Laplacian, and the first $2k$ partial derivatives of u exist, then $\Delta^k r^{2k-2}u = 0$ in the same region, r being the distance to an arbitrary point, which is taken as origin. A proof of this theorem is given, based on 2 lemmas: (1) $\Delta r\partial u/\partial r = 0$, (2) $\Delta r^{2k}u = r^{2k}\Delta u + 4kr^{2k-1}(\partial u/\partial r) + 4k^2r^{2k-2}u$, and on the (proved) theorem that a solution of $\Delta^k u = 0$ may be expressed as a series of harmonic functions. This opens the way to a proof of the existence of a solution to $\Delta^k u = 0$ inside a closed curve, which, with its first $k-1$ derivatives, assume given values at the boundary. The theorem is extended to 3 dimensions. J. A. W.

517.948.32 2218

A graphical method for the numerical solution of Fredholm's integral equation of the second kind. TEA, P. L. *J. Math. Phys.*, **24**, 109–25 (*May*, 1945).—A graphical method is devised for converting the Riemann integral

$$I = \int_a^b \phi(y)K(y)dy$$

into its equivalent Stieltjes integral

$$I = \int_A^B \phi(y)dY(y),$$

where $$Y(y) = \int_0^y K(y)dy$$

and $$B = Y(b), \quad A = Y(a), \quad Y(0) = 0,$$

and it is shown how the numerical values of either of the first two integrals may be obtained for numerical values of a and b. The integral curve $Y(y)$ is called the functional line of $K(y)$. The properties of the functional line are deduced and an application of it is made to harmonic analysis and to Fredholm's integral equation, the first two iterated functions forming the reciprocal kernel being calculated. A problem in the interreflexion of light on a surface is also studied by this method. L. S. G.

517.948.32 2219

Differential equations in Fréchet differentials occurring in integral equations. MICHAL, A. D. *Proc. Nat. Acad. Sci., Wash.*, **31**, 252–8 (*Aug.*, 1945).—The resolvent kernels and solutions of Volterra and Fredholm integral equations are regarded as functionals of the given kernels, and a study is made of the completely integrable equations characterizing these functionals. Applications include the setting up of approximations to the resolvent kernels and the solutions of integral equations with precise estimates of the errors. A theorem is given concerning the matrix exponential function in non-commutative analysis. L. S. G.

518.12 : 517.392 *see Abstr.* 2213

518.3 2220

Construction of nomographs with hyperbolic coordinates. BURROWS, W. H. *Industr. Engng Chem.*, **38**, 472–7 (*May*, 1946).—The problem of adjusting the moduli and positions of the scales of a nomo-

graph, in order to increase accuracy and legibility, is treated from the standpoint of the co-ordinate system rather than the defining equation of the nomograph. A co-ordinate system is described such that variations in the value of a single factor, r, will produce the desired variations in the positions and moduli of the scales. The general defining equation for nomographs is derived and shown to be independent of r. Thus the scale arrangements can be altered without changing the original equation of the nomograph. The mechanics of constructing nomographs on this co-ordinate system and the method of selecting the desired value of r are illustrated by the construction of three nomographs.

518.43 2221

A new method of integration by means of orthogonality foci. POPOFF, A. A. *Quart. Appl. Math.*, **3**, 166–74 (*July*, 1945).—The method, which is partly graphical and partly analytical permits a determination of integrals of the form

$$\int \phi_i(x)\phi_k(x)dx$$

where $\phi_i(x)$ is given graphically and $\phi_k(x)$ either graphically or analytically. The method requires the construction of diagrams showing the abscissae of the centroids of certain areas associated with $\phi_k(x)$. It is applied to interpolation, Fourier analysis and the evaluation of Mohr integrals in the theory of structures. L. S. G.

518.43 2222

On A. A. Popoff's method of integration by means of orthogonality foci. ROBINSON, H. A. *Quart. Appl. Math.*, **3**, 383–4 (*Jan.*, 1946).—Brief remarks on the method [Abstr. 2221 (1946)] in which certain calculations are redundant. L. S. G.

518.5 : 517.512.2 : 548.73 : 621.3.018.3 2223

A machine for the summation of Fourier series. HÄGG, G., AND LAURENT, T. *J. Sci. Instrum.*, **23**, 155–8 (*July*, 1946).—A machine is described which will perform a purely electric summation of Fourier series. The actual machine constructed can add 16 sine and 16 cosine terms, but there is nothing to prevent an increase in the number of terms. The sum of the series can be determined directly at intervals of 6° over the range 0–2π. The machine is principally intended for performing Fourier synthesis in X-ray crystallography. It can also be used for harmonic analysis.

519.241.6 : 53.088.3 *see Abstr.* 2249

519.242 : 621.394.44 2224

The probability distributions of sinusoidal oscillations combined in random phase. SLACK, M. *J. Instn Elect. Engrs, Pt III*, **93**, 76–86 (*March*, 1946).—[Abstr. 2124 B (1946)].

519.271.0 : 541.182.3 2225

A particle-size distribution function for air-borne dusts. LIDWELL, O. M. *Nature, Lond.*, **158**, 61–2 (*July* 13, 1946).—The following function has been found useful in problems involving the sedimentation or transport of air-borne bacteria-carrying dusts. $Y_s = CS^n \exp(-\alpha S)$ where S is the settling rate of a particle in still air, Y_s is the frequency of occurrence of particles with settling rate S, C is a normalizing coefficient $\left(= 100\frac{\alpha^{n+1}}{\Gamma(n+1)} \text{ for 100 particles}\right)$ and n and α are constants. This distribution has the important property of persisting without change of form during sedimentation of the dust. Its relation to other distribution formulae is briefly discussed with the aid of a graph.

519.48 : 513.881 2226

The total differential equation for the exponential function in non-commutative normed linear rings. MICHAL, A. D. *Proc. Nat. Acad. Sci., Wash.*, **31**, 315–17 (*Sept.*, 1945).—A normed linear ring is defined and the exponential function in such a ring is characterized by a total differential system in Fréchet differentials [see Abstr. 2219 (1946)]. L. S. G.

ASTRONOMY . GEODESY 52

521.034 = 4 2227

On stellar fission. SEVIN, É. *C.R. Acad. Sci., Paris*, **222**, 593–7 (*March* 11, 1946) *In French.*—From results for a particle vibrating relative to rotating axes, it is suggested that free oscillations of a rotating body should increase without limit if their period is half the period of rotation. T. G. C.

522.61 : 535.33.087.5 : 778.344 *see Abstr.* 2429

522.615 : 621.385.15 2228

Application of the multiplier phototube to astronomical photo-electric photometry. KRON, G. E. *Astrophys. J.*, **103**, 324–9 (*May*, 1946).—Details are given of considerable advances during recent years in the production of electron multipliers. The value of signal to noise ratio has been much reduced and cooling to −78°C assists in this. The new tubes have been used on telescopes for colour determinations and it is claimed that under ideal conditions the sensitivity of photographic plates is equalled. E. G. M.

523.161 : 533.6.011 2229

Some problems of the motion of interstellar gas clouds. I and II. BURGERS, J. M. *Proc. K. Ned. Akad. Wet.*, **49** (*No.* 6) 589–607 (1946).—The equations of hydrodynamics are applied to the motion of interstellar gas clouds, these being assumed to consist of hydrogen and to obey the perfect-gas law. One-dimensional motion only is considered, the first problem being that of the expansion of a homogeneous mass into a vacuum. A wave of expansion is formed, the front of which moves with 3 × the velocity of sound, the rear moving inwards with that velocity. Expansion with compression of a surrounding gas of low density is next treated and the shock waves produced are analysed. The effect of the gravitational attraction of a cloud on itself is shown to be small. The collision of two clouds moving with equal and opposite velocities and the collision of a moving cloud with one at rest are also discussed. The latter problem leads to the consideration of a quasi-stationary wave-

system with a barometric pressure gradient. The possibility of surface waves on interstellar clouds is analysed with special reference to the magnitudes of the Reynolds, Froude and Mach numbers involved. No definite conclusions can yet be reached regarding such waves. Throughout the paper numerical estimates of all effects are given on the basis of data supplied by J. H. Oort. G. C. McV.

523.21 : 530.145 *see Abstr.* 2254

523.63 2230

Note on the future orbit of Comet Delavan (1914 V). Van Biesbroeck, G. *Astrophys. J.*, **101,** 376 (*May,* 1945).—The motion of this comet (of which the orbit was hyperbolic near perihelion) is integrated forward for 20 yr, allowing for perturbations by the 4 major planets. The elliptical character becomes more pronounced than at the corresponding interval before perihelion, and the aphelion distance is reduced from 170 000 astronomical units to 16 000. A. HU.

523.75 : 550.385 = 4 2231

The relation between magnetic storms and solar eruptions. Burgaud, M. *C.R. Acad. Sci., Paris,* **222,** 449–50 (*Feb.* 18, 1946) *In French.*

523.752 2232

The distribution and movements of solar prominence areas. Moss, W. *Ann. Solar Phys. Obs., Cambridge,* **3** (*No.* 3) 119–28 (1946).—This paper is based on material mainly from Kodaikanal Observatory from 1904–28 covering three sunspot maxima and two minima. The position and length of base of each prominence is shown graphically. The most prominent features visible in the graph are described and the daily sidereal motion of recurrent prominences tabulated. E. G. M.

523.77 2233

A theoretical discussion of the continuous spectrum of the sun. Münch, G. *Astrophys. J.*, **102,** 385–94 (*Nov.*, 1945).—The observations of intensity of the sun's continuous spectrum, and of darkening in different wavelengths, are discussed in the light of Chandrasekhar's recent work [Abstr. 2027 (1946)]. The different types of observation now give consistent estimates of the variation of opacity with wavelength. Between 4 000 and 16 000 Å, these confirm that nearly all the opacity is due to H^- ions. T. G. C.

523.775.5 = 3 2234

Extinction of the coronal [FeX]$3s^23p^5\ ^2P_{\frac{1}{2}} - {}^2P_{1\frac{1}{2}}$ line (6 374 Å) by prominences. Waldmeier, M. *Experientia,* **2,** 220–1 (*June* 15, 1946) *In German.*

523.775.5 : 535.334 *see Abstr.* 2299

523.821 : 523.873 *see Abstr.* 2247

523.821.5 2235

On some photoelectric measurements of polarization and colour made by the flicker method. Öhman, Y. *Ark. Mat. Astr. Fys.*, **32 B** (*No.* 1) 7 *pp.* (1945).—Describes results obtained by the use of a multiplier phototube [Abstr. 558 (1945)] attached to the 24-in photographic telescope at Stockholm to give photoelectric star colours. A graphical comparison of these results at a maximum sensitivity of λ5100 Å with those of Becker and Stebbins at λ4500 Å is given showing clearly the separation of reddened B type stars from those of normal colour. The accuracy is high for stars as faint as magnitude 7·5, the error being less than ·01 mag. in the usual colour index. 100 stars have been measured to date. E. G. M.

523.83 : 523.851.3 *see Abstr.* 2238

523.841.9 2236

The spectroscopic orbit of RZ Eridani. Cesco, C. U., and Sahade, J. *Astrophys. J.*, **101,** 370–3 (*May,* 1945).—Orbital elements are derived from 52 McDonald spectrograms. The system consists of a "metallic-line" main-sequence star, whose spectrum in the region 4 000–4 300 Å is F5, luminosity class V, which at primary minimum is eclipsed by a sub-giant G8 star surrounded by an envelope of Ca gas. A. HU.

523.841.9 : 523.872 *see Abstr.* 2245

523.842.3 2237

The Wolf–Rayet spectroscopic binaries HD 186943, HD 193928 and HD 211853. Hiltner, W. A. *Astrophys. J.*, **101,** 356–69 (*May,* 1945).—Detailed spectroscopic investigations and radial velocity measurements are made for these stars. In the first, the velocity curves of the He II and N V emission bands of the WN 5 component give discrepant amplitudes and phases. Hydrogen absorption lines belonging to the B-type companion are measured, and orbital elements are derived. The emission and absorption features give different gamma-velocities. In the second star, for which orbital elements are also given, absorption features are found corresponding to He I lines displaced to the violet by about 1 200 km/sec. Elements are derived from the emission bands in the third star. The gamma-velocities here also differ as between absorption and emission lines. The available data on discrepant gamma-velocities are collected and discussed. A. HU.

523.851.3 : 523.83 2238

Investigations on proper motion. XXIV. Further measures in the Pleiades cluster. van Maanen, A. *Astrophys. J.*, **102,** 26–31 (*July,* 1945).—Intercomparison of 5 pairs of plates of the Pleiades taken at the 80-ft focus of the Mount Wilson 60-in telescope with a 25 yr interval shows that of 452 stars down to photographic magnitude 15·9, 71 have proper motions which make it likely that they are members of the cluster. A. HU.

523.854.1 2239

The Milky Way in Monoceros. Bok, B. J., and Rendall-Arons, J. M. *Astrophys. J.*, **101,** 280–99 (*May,* 1945).—The section of the Milky Way between galactic longitudes 176° and 186° is so uniform that it is probably little affected by irregular obscuration. Spectral types and colours down to stars of apparent magnitude 11·5, and general star counts to $m = 14{\cdot}5$ are used to deduce the variation of star density with distance from the sun. The general photographic absorption is found to be about 0·6 mag/kpc for distances up to 2 000 parsecs in the least obscured regions. With this value, the star densities nowhere increase markedly with distance and the steepest negative gradients are shown in the *F* stars. Marked variations in the shape of the general luminosity function exist over the first 500 parsecs. A. HU.

523.854.1 2240

The stellar distribution for two southern fields. Bok, B. J., and Wright, F. W. *Astrophys. J.*, **101,** 300–13 (*May,* 1945).—Two fields in the Milky Way

at galactic longitudes 261° and 249° are examined for stellar distribution. In the first field no obscuration is found to 1 600 parsecs, and the density distribution resembles that in Monoceros [see Abstr. 2239 (1946)] except that the *B*-star density does not decrease with distance. In the second field the average photographic absorption to 1 200 parsecs amounts to 0·5 mag/kpc and the density again resembles the Monoceros distribution. Further evidence is given for marked changes in the shape of the luminosity function within 200–500 parsecs of the sun. A. HU.

523.854.1 2241

Density gradients in the anticentre region of the Milky Way. McCUSKEY, S. W. *Astrophys. J.*, **102,** 32–42 (*July*, 1945).—Thirteen apparently unobscured regions of the Milky Way between longitudes 142° and 184° are examined on Schmidt camera plates. Counts down to $m = 17$ involving 42 000 stars give the space-density distribution. When interstellar absorption based on colour excesses is allowed for, the density functions resulting from a numerical solution show an excess of high-luminosity stars closer than 500 parsecs in the region 145°–165°; a steep negative gradient over most of the area which reduces the density by a factor of 5 at 2 500 parsecs; and a region of high density (0·5–0·8 × that near the sun) extending to 3 000 parsecs between longitudes 175° and 185°. A. HU.

523.854.3 2242

An investigation on differential galactic rotation. PISMIS, P., AND PRIETO, A. *Astrophys. J.*, **101,** 314–19 (*May*, 1945).—A new reduction of existing radial velocities of B-type stars for galactic rotation is carried through, using photometric distances corrected for general absorption. The material comprises 707 stars for which Victoria radial velocities are available and for which photo-electric colour excesses have been determined. The rotation coefficient *A* is independent of distance and has a mean value 0·011 ± 0·002 km/sec per parsec. The discrepancy between this figure and the previously accepted value of 0·017 is shown, by subdividing the material, to be due to an overestimate of the distances of the B3–B9 stars. The *K*-term practically vanishes in the nearest group. The large values hitherto obtained are attributed to non-uniform distribution in longitude. A. HU.

523.872 2243

Curve of growth for α Persei. STEEL, H. R. *Astrophys. J.*, **102,** 43–63 (*July*, 1945).—McDonald coudé spectrograms of this F5 supergiant are used to determine equivalent widths for 403 lines. These are used, together with existing solar data, to construct an empirical curve of growth. The excitation temperature derived for Fe I is 4 400°. By fitting a theoretical curve to the observed one, the average atomic velocity is found to be 3·7 km/sec (of which 3·4 km/sec is due to turbulence) and the mean damping constant $1{\cdot}2 \times 10^{-6}$, nearly 10× the classical value, and close to that observed for the sun. The chemical composition of the atmosphere is derived from the observed curve of growth. The electron pressure at the base of the reversing layer is 4·7 dyne/cm², about $\frac{1}{8}$ that in the sun. A. HU.

523.872 2244

Six-colour photometry of stars. III. The colours of 238 stars of different spectral types. STEBBINS, J., AND WHITFORD, A. E. *Astrophys. J.*, **102,** 318–46 (*Nov.*, 1945).—[See Abstr. 2708 (1945), 2682 (1943)]. 238 stars have been measured photo-electrically through six filters at Mount Wilson during the last five years. The stars are of types ranging from O to M and the wavelength range is λ3530 to λ10300. Space reddening affects many early type stars and some late type stars in low latitudes. The effect of absolute magnitude is greatest at type K0. Colour temperatures are derived, based on ten stars of type *d*G6, assumed temperature 5 500°K. The absolute zero-point has not been fixed. With results from six colours comparisons are possible with the International colours and the previous colour determinations of the North Polar Sequence. The comparison with Greenwich gradients show very good agreement and no outstanding discordances. Hall's results, referred to the mean of A0 stars, give a satisfactory comparison. E. G. M.

523.872 : 523.841.9 2245

The presence of strong lines of O I in the infra-red spectrum of *VV* Cephei. HYNEK, J. A., AND KEENAN, P. C. *Astrophys. J.*, **101,** 270–4 (*May*, 1945).—The red component of this eclipsing binary has a normal M2 supergiant spectrum in the region 7 200–8 700 Å except for the intensity of the O I absorption lines at 7 773 Å and 8 446 Å, which are as strong as would be expected in supergiants of types B to F. It is suggested that the O atoms concerned are in the atmosphere of the M star and are excited by resonance absorption of the radiation of the B component near 1 300 Å. A. HU.

523.872 : 535.343 2246

On the continuous absorption coefficient of the negative hydrogen ion. II. CHANDRASEKHAR, S. *Astrophys. J.*, **102,** 395–401 (*Nov.*, 1945).—The determination of Abstr. 2025 (1946) is improved by taking into account the effect of the static field of the H ion on the motion of the ejected electron. The absorption cross-sections of H^- are evaluated for various wavelengths; the new values are found to be about 5% larger in the visual and near infra-red regions. The maximum in the new absorption curve occurs at about λ8500 Å; the corresponding value of the atomic absorption coefficient is $4{\cdot}52 \times 10^{-17}$ cm². V. C. A. F.

523.873 : 523.821 2247

The use of infra-red spectra for the determination of absolute magnitudes. KEENAN, P. C., AND HYNEK, J. A. *Astrophys. J.*, **101,** 265–9 (*May*, 1945).—Criteria are detailed which will place into 5 luminosity classes stars of type M from their infra-red spectra obtained at moderate dispersion. The most sensitive feature is a blend at 8 514 Å due partly to a component of a low-lying multiplet of Fe I. The range used is 7 000–8 700 Å and the resolving power attained is about 2 magnitudes. The criteria should be useful in studying the red components of spectroscopic binaries in which the blue region is dominated by the light of the hotter component. A. HU.

PHYSICS 53

53.087.252 : 778.37 *see Abstr.* 2430

53.088 : 543 2248

Improvement of precision by repeated measurements. Application to analytical control methods. MANDEL, J. *Industr. Engng Chem.* (*Analyt. Edit.*) **18,** 280–4 (*May*, 1946).—This article critically examines replication of measurements as a means of increasing precision. Formulae are provided for evaluating such improvement of precision in any given case and for computing confidence limits in routine analysis.

53.088.3 : 519.241.6 2249

Experimental data and "sufficient" accuracy. HUGHES, H. A. *Nature, Lond.*, **158,** 29 (*July* 6, 1946).

FUNDAMENTALS 530.1

530.12 : 531.18 *see Abstr.* 2258

530.12 : 531.51 2250

Deflexion of light in the gravitational field without using Einstein geometry. KIANG, S.-C. *Nature, Lond.*, **157,** 842 (*June* 22, 1946).—[See Cheng, *ibid.*, **155,** 574 (1945)].

530.12 : 531.51 *see Abstr.* 2265

530.12 : 538.56 *see Abstr.* 2350

530.14 : 535.14 = 4 2251

Interaction energy and the theory of multipole radiation. HUMBLET, J. *Physica, 's Grav.*, **11,** 91–9 (*Feb.*, 1944) *In French.*—The interaction energy of a system of charged particles in an electromagnetic field is expanded in terms of the multipole moments of all orders and the space derivatives (taken at a fixed point) of the electric and magnetic fields. With this expansion it is possible to calculate the transition probabilities for all multipole orders. L. S. G.

530.14 : 539.153.4 : 535.14 = 4 2252

Theory of multipole emission and absorption. HUMBLET, J. *Physica, 's Grav.*, **11,** 100–13 (*Feb.*, 1944) *In French.*—The results of a previous paper (Abstr. 2251 (1946)] are used to calculate the transition probabilities for emission and absorption by electrical 2^{l+1} polar processes and magnetic 2^{l+1} polar processes. The probabilities for electrical 2^{l+1} polar processes and magnetic 2^{l} polar processes are generally of the same order of magnitude and there is no "interference" between 2 such probabilities. Emission and absorption by hydrogenic atoms are discussed briefly. L. S. G.

530.145 2253

An attempt to formulate a divergence-free quantum mechanics of fields. RAYSKI, G. *Nature, Lond.*, **157,** 873 (*June* 29, 1946).

530.145 : 523.21 2254

Quantization of the solar system. BARNÓTHY, J. *Nature, Lond.*, **157,** 808 (*June* 15, 1946).—It is postulated that Planck's constant is not a universal physical constant, but is always dependent on the value of the spin of the particle under consideration. Thus the principal quantum number in the case of the Bohr atom is given by n = (orbital impulse)/2 × (electron spin). Application is then made to the planets and the relation n = orbital impulse/2 × (planetary spin) × 137^k is found to be obeyed with small integral values of n (1 to 4) and k (2 or 3). The explanation of the factor 137 is not known. The prediction of the hitherto unknown revolution periods of Venus, Mercury and Pluto is suggested as an opportunity for experimental confirmation.

530.145 : 537.122 2255

A non-radiating motion of a spinning electron. WEYSSENHOF, J. W. *Nature, Lond.*, **157,** 809 (*June* 15, 1946).

530.145 : 537.122 2256

Two relativistic models of Dirac's electron. WEYSSENHOFF, J. W. *Nature, Lond.*, **157,** 842 (*June* 22, 1946).

530.162 : 621.38 2257

Statistical analysis of spontaneous electrical fluctuations. FÜRTH, R., AND MACDONALD, D. K. C. *Nature, Lond.*, **157,** 807 (*June* 15, 1946).—[Abstr. 2091 B (1946)].

MECHANICS OF SOLIDS 531

531.18 : 530.12 2258

The Lorentz distribution. HILTON, P. J.; STRAUSS, M. D. H. *Nature, Lond.*, **158,** 62 (*July* 13, 1946).—Correction [see Abstr. 1514 (1946)].

531.19 : 536.71 : 532.7 *see Abstr.* 2280

531.19 : 541.183 *see Abstr.* 2391

531.19 : 541.61 : 536.7 *see Abstr.* 2330

531.224.7 : 621.643.042 = 3 2259

On the yielding of ribbed tube expansion pieces. SALZMANN, F. *Schweiz. Bauztg*, **127,** 127–30 (*March* 16, 1946) *In German.*—[Abstr. 1950 B (1946)].

531.258 2260

Thermal deflections of anisotropic thin plates. PELL, W. H. *Quart. Appl. Math.*, **4,** 27–44 (*April*, 1946).—A thin elastic plate is considered which has one plane of elastic symmetry parallel to the faces of the plate, and is subjected to a temperature distribution given by the function, $T(x, y, z) = T_0(x, y) + zT_1(x, y)$. Two partial differential equations governing the deflection of the plate are derived: one of these defines a stress function, the other the deflection function, and the first equation is solved in the case where T_0 is a polynomial. It is difficult to solve the equation for the deflection but the thermal deflection problem for an isotropic circular plate with radial temperature distribution is solved, in the form of a power series, and convergence is established. Boundary conditions for the clamped and simply supported plate are considered, and the deflection is found for each of these modes of support. L. S. G.

531.259.2 2261

Stresses and small displacements of shallow spherical shells. I. REISSNER, E. *J. Math. Phys.*, **25,** 80–5 (*Feb.*, 1946).—A system of equations for use in the analysis of shallow segments of thin elastic spherical shells is obtained. A segment is called shallow if the ratio of its height to base diameter is less than about $\frac{1}{8}$. There are 11 equations for the 8 stress resultants and couples and the 3 displacements. These are reduced to a problem of 2 equations for 2 unknowns and when

this is solved explicit solutions for the quantities of interest may be obtained. L. S. G.

531.259.2 2262

Thin cylindrical shells subjected to concentrated loads. YUAN, S. W. *Quart. Appl. Math.*, **4**, 13–26 (*April*, 1946).—The equations of equilibrium of a shell are found and reduced to a single differential equation of the eighth order in the radial displacement. This is applied to an infinitely long thin cylinder, and integrated by the Fourier method. A cylinder of finite length, loaded with two equal and opposite forces is next considered, the solution in this case being obtained by an image method. Finally an analysis is made of the problems of a couple acting on an infinitely long cylinder in the direction of either the generatrix or the circumference. L. S. G.

531.31 2263

Reducible dynamical systems. THOMAS, T. Y. *J. Math. Phys.*, **25**, 89–91 (*Feb.*, 1946).—Consider a conservative dynamical system D referred to generalized co-ordinates $x^1, x^2, \ldots, x^n$. A reducible system is defined and it is proved that D is reducible if and only if it admits a quadratic first integral

$$\tfrac{1}{2}h_{\alpha\beta}(x)\frac{dx^\alpha}{dt}\frac{dx^\beta}{dt} + W = \text{const.}$$

distinct from the energy integral, such that $h_{\alpha\beta,\gamma} = 0$ where the quantities $h_{\alpha\beta,\gamma}$ are the components of the covariant derivative of the tensor h defined by the coefficients $h_{\alpha\beta}$. L. S. G.

531.382 2264

The production of high centrifugal fields. BEAMS, J. W., AND YOUNG, J. L., III. *Phys. Rev.*, **69**, 537 (*May* 1 *and* 15, 1946).—A rotor of small radius spinning at high speed offers the most favourable conditions. Using the methods described in Abstr. 2488 (1941) a 3·97 mm steel ball was spun to reach a peripheral speed of $9{\cdot}6\times10^4$ cm/sec, at which it burst. A 1·59 mm ball was spun at 166 000 r.p.s. without bursting, producing a centrifugal field of $8{\cdot}8\times10^7\,g$ at the periphery.

531.51 : 530.12 2265

The two-body problem in Einstein's and Birkhoff's theories. MORRIS, T. F. *Phys. Rev.*, **69**, 541 (*May* 1 *and* 15, 1946).

531.51 : 530.12 *see Abstr.* 2250

531.55.011 : 629.135 2266

Approximate calculation of the range of a winged jet projectile. KRZYWOBLOCKI, M. Z. *J. Appl. Phys.*, **17**, 515–19 (*June*, 1946).—The problem is considered from one standpoint only, i.e. that of mass ratio, and is treated in simplified form for the beginning and end of flight. The simplified equations of 3 periods of flight are given: climbing, horizontal flight and gliding. A short example shows that the required mass ratio for a flight of 2 000 or 3 000 miles is high.

MECHANICAL MEASUREMENTS 531.7

531.7 : 621.317.39 = 4 2267

Recent improvements in electrical methods of measuring forces, accelerations and displacements. GONDET, H. *Rev. Gén. Élect.*, **55**, 123–36 (*April*, 1946) *In French.*—[Abstr. 1834 B (1946)].

531.768.5 2268

A uniform method for determining angular accelerations in mechanisms. KOENIG, L. R. *J. Appl. Mech.*, **13**, *A*41–4 (*March*, 1946).—This paper describes a reliable and uniform method, applicable to mechanisms in general. Its advantages are: (*a*) only velocity-vector considerations are required in the necessary kinematic layouts; (*b*) full advantage may be taken of the process of inversion in simplifying velocity-vector layouts, which is not possible when acceleration vectors are employed; and (*c*) the method gives considerable insight into the effects of the various factors controlling the angular accelerations.

531.788.13 2269

A Knudsen absolute manometer. WILLIAMS, S. E. *J. Sci. Instrum.*, **23**, 144–6 (*July*, 1946).—The paper describes an attempt to simplify the design of DuMond and Pickels [Abstr. 109 (1936)] and at the same time to make the gauge an absolute instrument. Details of its construction are given, as well as information about its performance and limitations. The range of practical operation is about 10^{-4} to 10^{-6} mm Hg.

531.789.1 : 621.317.788 2270

An automatic method of measuring torque and counting load cycles. WOLKEN, J. J. *Instruments*, **19**, 212–13 (*April*, 1946).—[Abstr. 2072 B (1946)].

MECHANICS OF LIQUIDS 532

532.123 : 539.42 2271

The behaviour of water under hydrostatic tension. I. TEMPERLEY, H. N. V., AND CHAMBERS, L. G. *Proc. Phys. Soc., Lond.*, **58**, 420–36 (*July*, 1946).—A review of the literature reveals very considerable differences in the values of critical tension obtained by different methods. Two methods are studied in detail: the Berthelot method, which makes use of the difference in expansions of glass and water, and the Reynolds centrifugal method. High pressures are apparently required to persuade water to stick to glass under subsequent tension. A modification of the Berthelot method gives results in much better agreement with other methods. Examination of the Reynolds method shows that account must be taken of the fact that water does not move as a rigid body. Although this has no appreciable effect on the pressure distribution, it does imply a considerable stirring of the water, and any small bubbles would tend to be brought near the region of greatest tension. The flow of water in constricted tubes is also studied. It is concluded that if tension is applied statically, ordinary water can stand tensions of the order of 40 atm, even if it is not perfectly air-free. Water nearly saturated with air has been shown to stand tension up to 6 atm.

532.123 : 539.42 2272

The behaviour of water under hydrostatic tension. II. TEMPERLEY, H. N. V. *Proc. Phys. Soc., Lond.*, **58**, 436–43 (*July*, 1946).—A further examination of the Berthelot method of producing tensions in liquids has been made. The critical tension of water has been measured by a method which does not assume that the extensibility and compressibility of water are equal, and other evidence in confirmation of this assumption has been obtained. It is concluded that

high pressures are necessary in the Berthelot tube to force the final gas bubble to dissolve in a reasonable time, and that this fact is probably due to the low rates of diffusion of gases through liquids. It is also concluded that there is a large discrepancy between the theoretical and the observed strength of water.

532.13 2273

The three coefficients of viscosity of anisotropic liquids. MIESOWICZ, M. *Nature, Lond.*, **158,** 27 (*July* 6, 1946).—The flow of an anisotropic liquid influences the orientation of the molecules; on the other hand, the viscosity depends on the orientation. Values have been obtained for the viscosity of *p*-azoxyanisol and *p*-azoxyphenetol with molecules previously oriented by a magnetic field for the 3 directions: molecules parallel to the direction of flow; molecules parallel to the velocity gradient; molecules perpendicular to the two former directions. The results are compared with those of earlier investigators.

532.5.081.5 2274

On dimensional analysis and the presentation of data in fluid-flow problems. VAN DRIEST, E. R. *J. Appl. Mech.*, **13,** *A*34–40 (*March*, 1946).—The method and application of dimensional analysis are discussed, making use of the fundamental concept of function. The π theorem is restated and proved in general form. Pipe friction, drag of spheres, and flow through Venturi meters are examples used to illustrate the rearrangement of dimensionless products of a relationship to obtain the most convenient form for presentation of data.

532.516 : 621.891.22 2275

Film-lubrication between spherical surfaces: with an application to the theory of the four-ball lubricant testing instrument. HOWLETT, J. *J. Appl. Phys.*, **17,** 37–49 (*March*, 1946).—Two equal spheres are placed in an infinite body of viscous liquid so that the minimum separation of the surfaces is small compared with the radius; one sphere is held at rest, the other rotates at constant speed. The assumption is made that the surfaces are separated by a continuous film of liquid to which the classical theory of hydrodynamical lubrication can be applied. The total force exerted by the liquid on the moving sphere, and the torque, acting on the fixed sphere, are deduced. The results are applied to the particular case of the four-ball lubricant testing instrument, in which a sphere is made to rotate about a vertical axis, under axial load, in the central space formed by a set of three equal spheres held stationary so as to touch one another with their centres in a horizontal plane; the whole set of spheres is immersed in the lubricant to be tested. The relations finally obtained express the load on the moving sphere and the torque on the set of fixed spheres in terms of the radius of the spheres, the velocity of rotation, and the viscosity of the liquid; they involve as a parameter the minimum separation of the spheres. The maximum load which can be supported by the moving sphere in the hydrodynamical regime cannot be expected to exceed a few hundred grams weight; for loads of greater order the standard continuous-film theory cannot hold, and the forces on the spheres are no longer determined by the viscosity of the liquid.

532.612.4 2276

A test of Langmuir's interpretation of the Jones–Ray effect. WOOD, L. A., AND ROBINSON, L. B. *J. Chem. Phys.*, **14,** 258–62 (*April*, 1946).—Jones and Ray observed a minimum in the surface tension-concentration curve of electrolyte solutions at about 0·001 *N* [Abstr. 493 (1941)]. Langmuir interpreted this as an instrumental effect rather than a real minimum, and advanced a quantitative theory by which the surface tension data could be corrected [Abstr. 140 (1939)], involving the zeta-potentials of vitreous silica in contact with the solutions measured. Using the zeta-potentials with barium chloride solutions recently measured [Abstr. 2387 (1946)], the Langmuir theory was strikingly substantiated.

532.66 : 539.217.1 = 4 2277

Contribution to the study of the phenomenon of capillary imbibition. GINIEWSKI, O. I. *Experientia*, **2,** 221–2 (*June* 15, 1946) *In French.*—The real density of a porous substance can be determined by the equation $V = a - bs$, where V is the volume of imbibition, s the surface tension, a and b experimental constants. It is concluded that a represents the total porous volume while b is a function of the mean porous radius. The ratio b/a defines a characteristic porosity index.

532.68 : 621.791.353 2278

Capillary flow in the soldering process and some measurements of the penetration coefficients of soft solders. LATIN, A. *J. Inst. Met.*, **72,** 265–82 (*April*, 1946).—[Abstr. 2180 B (1946)].

532.7 2279

Hole theory of the liquid state. TSENG, T.-P. *Nature, Lond.*, **157,** 873–4 (*June* 29, 1946).

532.7 : 531.19 : 536.71 2280

On phase changes of Bose–Einstein fluid models. GOLDSTEIN, L. *J. Chem. Phys.*, **14,** 276–82 (*April*, 1946).—It is shown that all Bose–Einstein (B.E.) fluid models investigated thus far undergo first-order transformations in phase space. The ideal fluid condenses smoothly, e.g. without any possibility of supersaturation, in so far as its thermodynamic characteristic functions and their first derivatives, with respect to the independent variables, are continuous along the transition or saturation curve. The non-ideal B.E. fluids considered, in which attractive interatomic forces averaged over the volume of the fluid are assumed to operate, undergo sudden condensation strictly similar to that exhibited by ordinary fluids in co-ordinate space. This process is accompanied by the occurrence of discontinuities of the first derivatives of the characteristic functions. By introducing a suitable repulsive interatomic force, smeared over the volume of the fluid, the smooth condensation of the ideal fluid is changed to a phase transformation of the third order. Here the second derivatives of the characteristic functions exhibit discontinuities along the transformation curve. The same interatomic force lifts the order of the sudden first-order transformation by changing it to a second-order one. This is accompanied by the appearance of the λ-point type discontinuity of the constant pressure heat capacity along the transition or λ line. The interplay of forces of parallel and opposing tendencies in modifying the nature of a phase transformation

without changing its order and in lifting or lowering their order is thus brought out. The bearing of these results on the problems connected with the thermal properties of liquid He is touched upon briefly.

532.72 = 3 2281

Theory of diffusion of ternary solutions. LAMM, O, *Ark. Kemi Min. Geol.*, **18 A** (*No.* 1) *Paper* 2, 10 *pp.* (1944) *In German.*

MECHANICS OF GASES 533

533.15 : 539.217.5 : 541.64 2282

On the diffusion of vapors through polymers. DOTY, P. *J. Chem. Phys.*, **14**, 244–51 (*April*, 1946).—The rate of permeation of a gas through a polymer as a function of temperature may be represented as $P = P_0 e^{-E/RT}$. All available data on the permeability of gases through polymers show that for a given gas there is a linear relation between $\log P_0$ and E (the energy of activation for permeation). An explanation is offered for this apparent relationship. The effect of plasticization on permeation of water vapour is studied experimentally and it is shown that the lowering of the heat of solution is the predominant effect. From the data the entropy of solution may be calculated and interpreted as showing that water molecules dissolved in the unplasticized polymer exhibit much less freedom than when they are dissolved in plasticized polymer. Other calculations show (in agreement with Barrer) that a large number of degrees of freedom are simultaneously operative in the process of the diffusion of a gas molecule through a polymer.

533.6.011 : 523.161 *see Abstr.* 2229

533.6.011.311 2283

Laminar boundary layer in compressible fluid. DORODNITZYN, A. *C.R. Acad. Sci., URSS*, **34** (*No.* 8) 213–19 (1942).—Making the simplifying assumption that Prandtl's number has the value unity, the author discusses mathematically the problem of the laminar boundary layer in the case of streamline flow of compressible fluid past a stream-lined body of arbitrary profile under the condition that there is no heat transfer between the body and the fluid. J. S. G. T.

533.6.011.4 : 533.6.07 2284

On the propagation of small disturbances in a moving compressible fluid. CARRIER, G. F., AND CARLSON, F. D. *Quart. Appl. Math.*, **4**, 1–12 (*April*, 1946).—It is shown that the wave fronts associated with those parts of a disturbance which are derivable from a potential propagate in a rotational stream according to the laws which they are known to obey in an irrotational stream; also, the rotational disturbances drift with the stream rather than propagate relative to the moving fluid. A perturbation method is applied to the Navier–Stokes and continuity equations and the equations so derived are solved by the theory of characteristics. The results give a general expression for the Mach lines of an arbitrary supersonic flow and suggest a new method of wind tunnel calibration which eliminates the need for placing an obstacle in that portion of the stream being calibrated. Predictions are made as to the nature of pulses which are formed at a surface and propagate through a boundary layer into a uniform stream. L. S. G.

533.6.07 : 533.6.011.4 *see Abstr.* 2284

ACOUSTICS . VIBRATIONS 534

534.142 : 545.71 228

An optical-acoustic method of gas analysis. VEN GEROV, M. *Nature, Lond.*, **158**, 28–9 (*July* 6, 1946).—Infra-red irradiation of a gas, interrupted at soni frequencies, produces a sound whose intensity depend on the absorption of infra-red energy by the ga This principle is utilized in an analyser which wi determine the quantitative composition of a ga mixture whose qualitative composition is knowr Oxygen, hydrogen and nitrogen cannot be detecte as they do not absorb infra-red radiation. Ether ca be detected in a concentration as low as 0·1 mg/litr of air.

534.213 : 534.222.2 = 393 228

The one-dimensional propagation of pressure disturbances in an ideal gas. BURGERS, J. M. *Vers Ned. Akad. Wet. Afd. Natuurk.*, **52** (*No.* 8) 476–84 (*No.* 9) 560–70 (1943) *In Dutch.*—The problem refer to the propagation of compression and expansio waves in an ideal gas, contained in a semi-infinit cylindrical tube, closed at one end by a movabl piston. The effects of friction, heat conduction an radiation are neglected. Starting from a state of res the piston at the instant $t = 0$ is suddenly set int motion with the constant velocity V; at the instan $t = t_1$ the motion is suddenly stopped. At $t =$ a discontinuous compression wave (Riemann shoc wave) is generated; at $t = t_1$ an expansion wave i formed, which will overtake the shock wave after certain interval of time. From this instant th intensity of the shock wave begins to diminish, thi process being accompanied by the formation o reflected compression waves of small intensity, and o frontiers at which the entropy of the gas changes The interaction between the compression waves, th entropy frontiers and the original expansion waves i considered, and a construction is given which make it possible to obtain an approximate picture of the mos important features of the resulting wave system.

534.213 : 534.222.2 228

On the transmission of sound waves through a shoc wave. BURGERS, J. M. *Proc. K. Ned. Akad. Wet.*, 4 (*No.* 3) 274–81 (1946).—Similar phenomena t Abstr. 2286 (1946) occur when a shock wave is me by sound waves. The case of a stationary shoc wave is considered, forming the boundary betwee two regions in one of which the gas moves wit supersonic velocity and in the other with subsoni velocity. The boundary conditions are defined in th two cases where the sound wave is incident (*a*) in th supersonic region and (*b*) in the subsonic region The peculiar system of wave motion produced, i which there may or may not be reflection at th boundary layer, is explained on the basis of "entropy waves." When sound waves are superimposed on th shock wave, the change of entropy of the gas passing through it is no longer constant and a periodic field of entropy makes its appearance. A. B. W.

534.213.4 : 534.845 2288

The propagation of sound between walls of porous material. SCOTT, R. A. *Proc. Phys. Soc., Lond.*, **58**, 358–68 (*July*, 1946).—Deficiencies of existing theories relating to the propagation of sound along ducts lined with porous sound-absorbing materials are discussed.

...ttention is drawn to the wave-nature of the propaga-...on of acoustic disturbances in the lining material ...ee Abstr. 1268 (1946)], and a new theory is put ...rward in which the propagation of acoustic waves ...n the composite system of air space and lining is ...vestigated for two simple shapes of duct. The ...sults of the theory are in agreement with those of an ...arlier theory by Morse [Abstr. 4651 (1939)] as long ...s the attenuation in the duct is not large, but wide ...ivergences appear, in particular where the attenuation ...n the duct begins to approach that of the propagation ...f sound through bulk lining material. In the latter ...ase it is shown by a particular experimental example ...hat the attenuation found in practice is in agreement ...ith the theory described in this paper. [See also ...bstr. 2212 (1945)].

534.222.2 : 534.213 *see Abstr.* 2287

534.222.2 : 534.213 = 393 *see Abstr.* 2286

534.372 : 539.312 *see Abstr.* 2368

534.441 : 621.317.76 2289

Range extender for General Radio 760A sound analyzer. COBINE, J. D., AND CURRY, J. R. *Rev. Sci. Instrum.*, **17**, 190–4 (*May*, 1946).—[Abstr. 2070 B 1946)].

534.845 : 534.213.4 *see Abstr.* 2288

OPTICS . RADIATION . SPECTRA 535

535.1 2290

Change of frequency of a light wave by the variation of its optical path. HO, T. L., AND LUNG, W. S. *Nature, Lond.*, **158**, 63 (*July* 13, 1946).—A general formula is derived for the change of frequency, which gives the Doppler formula when applied to the case of change of length, but can be used for calculating the diffraction of light waves by supersonic waves, in the case of change of refractive index of the path. The change of frequency may be considered as change of photon energy due to work done in changing their linear momentum. A corresponding analogy is worked out for the case of a rotating doubly-refracting medium, where the work is done against a torque exerted on the medium by the turned-over photons.

535.14 : 530.14 = 4 *see Abstr.* 2251

535.14 : 539.153.4 : 530.14 = 4 *see Abstr.* 2252

535.214–15 : 778.344 = 4 *see Abstr.* 2428

535.215 2291

The photoelectric effect in metal-ammonia solution. OGG, R. A., JR. *J. Chem. Phys.*, **14**, 295 (*April*, 1946).—The previous studies [see Abstr. 1950 (1946)] of inner photo-electric effect (i.e. of photo-conductivity) of metal-ammonia solutions have been extended to include the external effect—i.e. the emission of electrons into the vapour phase just above the freezing point of NH_3. The highly dilute systems here studied displayed their maximum sensitivity in the near infra-red around 15 000 Å. They thus appear to possess a work function of the order of one-half of that of the concentrated solutions. [Abstr. 1934 (1941)]. A brief theoretical discussion is given [see also Abstr. 1894 (1946)].

535.215 : 537.533 2292

Photoelectric properties of metals in a finely divided state. REIMERT, L. J. *J. Opt. Soc. Amer.*, **36**, 278–83 (*May*, 1946).—When Cd, Sb and Zn surfaces are prepared by distillation in air instead of in vacuo, they are deposited in the form of a black powder. Curves of photo-electric current per unit light intensity as a function of wavelength are given (arbitrary units). Exposure to water vapour increased the photo-electric current in the case of Cd but not Zn or Sb. In the case of Na distilled in air, a considerable improvement in yield was observed, and the threshold wavelength became about 8 000 Å instead of the 4 800 Å for Na distilled in vacuo. N. C.

535.215.2 : 537.533 2293

Influence of polarized light on the falling-off effect of the limiting potential of Einstein's photoelectric law. MARX, E. *Phys. Rev.*, **69**, 523–9 (*May* 1 *and* 15, 1946).—[See Abstr. 2429 (1931)].

535.231 : 535.241.42 2294

Light emission during cooling of a Planckian radiator. CALDIN, E. F. *Proc. Phys. Soc., Lond.*, **58**, 23–50 (*July*, 1946).—General expressions are derived for the variation of luminous intensity with time, and the corresponding integral of the intensity with respect to time, for a Planckian radiator of uniform temperature, cooling by radiation from temperatures above 2 000°K. The time-intensity integral for light emitted in a given direction is found to depend only on the initial temperature, heat capacity and shape of the body; the form of the intensity-time curve depends also on the surface area and emissivity. Values of the time-intensity integral for a spherical total radiator of unit heat capacity, cooling from various temperatures, are tabulated. The relevance of these results to the study of certain light sources of short duration is indicated.

535.234 : 535.651 2295

Approximations to Planckian distributions. MOON, P., AND SPENCER, D. E. *J. Appl. Phys.*, **17**, 506–14 (*June*, 1946).—The use of Planck's equation in theoretical photometry and colorimetry has been hampered by the difficulty of integration. An attempt is made to replace Planck's equation in the visible region by simpler expressions that are easily integrated. Two such approximations are employed —a 3-term polynomial and the Wien function. The method applies even in the weighted integrations of colorimetry.

535.241.42 : 535.231 *see Abstr.* 2294

535.243 2296

Note on the measurement of spectral distributions when lines and continua are present together. LORD, M. P. *Proc. Phys. Soc.*, **58**, 477–80 (*July*, 1946).—The problem of evaluating the intensity of a line spectrum relative to that of a continuum is solved for the specific case of a double monochromator (the dispersions in the two halves of which are in the same direction) used in conjunction with a selective detector. The form of a function of the slit-widths and the dispersion required for the solution is derived analytically: a geometrical treatment given by Cittert is criticized. [See also Abstr. 1561 (1946)].

535.247.4 : 615.831.7 : 551.521.63 *see Abstr.* 2415

535.322.1.087.6 : 545.822/.823 2297

A photo-electric instrument for direct spectrochemical analysis. SAUNDERSON, J. L., CALDECOURT, V. J., AND

PETERSON, E. W. *J. Opt. Soc. Amer.*, **35**, 681–97 (*Nov.*, 1945).—A direct reading spectrometer for spectrochemical analysis, combining great speed, simplicity of operation, and exceptionally good analytical results, is described. The grating spectrometer is equipped with 11 electron multiplier phototubes allowing the determination of 10 elements using the internal standard method. The light intensities are integrated over a sparking period of 20 sec by storing the photo-currents in suitable capacitors. D.c. amplifiers of novel design perform the function of measuring the stored charges, and the results are recorded on a strip chart of electrical marking paper. A method is discussed for making a background correction which materially increases the sensitivity and accuracy for trace elements. Analytical results having a standard deviation of the order of 2% of the amount present in alloying constituents are regularly obtained by routine operators.

535.322.4 : 535.435 *see Abstr.* 2314

535.33 : 539.132 *see Abstr.* 2354

535.33.072 : 621.316.75.076.7 2298

Spectrograph exposure control. COSBY, J. R. *Electronics*, **19**, 123–5 (*April*, 1946).—An integrating method of recording the light energy developed in a grating spectrograph with a spark source that is changing in intensity. A part of the light from the arc is reflected from a rotating sector to a photocell, charging the grid of a gas discharge valve which on firing registers on an electromagnetic counter and then returns to its quiescent position. A series of cycles occur during one exposure, an integrated result being shown on a dial. After a preset number of cycles, a cam switch operating *via* a relay cuts off the arc. Should the arc fail during the exposure, the control instrument is switched off. Necessary precautions and further applications of the system are indicated. E. D. H.

535.33.087.5 : 522.61 : 778.344 *see Abstr.* 2429

535.334 : 523.775.5 2299

Possibility of emission of a very hard radiation from the solar corona. SHKLOVSKY, J. S. *Nature, Lond.*, **157**, 840 (*June* 22, 1946).—The resonance potential of Fe ions emitting coronal lines is about 35 V (according to Edlén). If the electron temperature of the corona is 350 000°c the mean kinetic energy of the electrons will also be about 35 V and the spectrum of the sun in the region of a few hundred Å should be lined.

535.338.1 : 539.15 *see Abstr.* 2358

535.338.4 2300

Extension of the *A–X* system of nitrogen. HERMAN, R. *Nature, Lond.*, **157**, 843 (*June* 22, 1946).—[See Abstr. 2533 (1940), 2846 (1934)].

535.339 : 537.531 *see Abstr.* 2340

535.339.3 : 535.417 : 535.39 *see Abstr.* 2312

535.341 2301

Note on measurements of glass absorption. SMITH, T. *Proc. Phys. Soc., Lond.*, **58**, 472–5 (*July*, 1946).—The theory of four methods of measuring the transmissivity of optical glass is given, with special reference to the effect of surface reflexion [see Abstr. 2080 (1946)]. The accuracy attained by all four methods is similar provided the appropriate conditions, which are more stringent in some cases than others, are satisfied.

535.341 : 536.33 *see Abstr.* 2323

535.341 : 545.82 *see Abstr.* 2398

535.342 : 541.57 2302

Interpretation of the regularities in the spectra of molecules forming the intermolecular hydrogen bond by the predissociation effect. STEPANOV, I. *Nature, Lond.*, **157**, 808 (*June* 15, 1946).

535.342–15 : 678 : 541.68 *see Abstr.* 2394

535.343 : 523.872 *see Abstr.* 2246

535.343.2 : 535.372 : 549.211 2303

Fluorescence and absorption patterns in diamond at low temperatures. MANI, A. *Proc. Indian Acad. Sci. A*, **20**, 323–8 (*Dec.*, 1944).—The patterns for ten cleavage planes of diamond, at liquid air temperature, were studied spectroscopically. The results show that a close correlation exists in blue luminescent diamonds between the variation in intensity of the principal electronic lines at 4 152 Å and those of the fainter lines at 4 197 and 4 206 Å and the subsidiary bands at longer wavelength, and in yellow luminescent diamonds between the intensities of the 4 152, 5 032 and 5 359 Å systems and the lines at 4 123 and 4 194 Å. The spectra of diamonds of the mixed type possess features characteristic of both the blue and yellow luminescent types. Variations in intensity and colour of the absorption spectra are identical with those in the fluorescence spectra, and give rise to absorption patterns in the visible corresponding to the patterns in luminescence. W. R. A.

535.343.3 : 539.133 *see Abstr.* 2356

535.343.3–15 2304

The infra-red spectra of *p*-benzene-d_2 and *p*-benzene-d_4. MILLER, F. A., AND CRAWFORD, B. L., JR. *J. Chem. Phys.*, **14**, 292–3 (*April*, 1946).—[See Abstr. 2356 (1946)].

535.343.4–14 : 538.569.4 : 539.13 2305

The inversion spectrum of ammonia. GOOD, W. E. *Phys. Rev.*, **69**, 539 (*May* 1 *and* 15, 1946).—The strong absorption band at 0·8 cm^{-1} has been resolved into 28 sharp lines (0·1 mm Hg pressure) which are shown graphically. A preliminary expression is given for the rotational spectrum formula. At about 10^{-2} mm Hg pressure a hyperfine structure was resolved. [See Abstr. 1583 (1946)].

535.361.2 2306

The light-diffusing properties of magnesium oxide. HARRISON, V. G. W. *Proc. Phys. Soc., Lond.*, **58**, 408–18 (*July*, 1946).—Measurements made on MgO deposited to a depth of 2 mm on Al show that, for angles of incidence up to 60°, the polar reflexion curves are in general ellipses, and not the circles required by Lambert's law. For angles of incidence less than 45°, the major axis of the ellipse is perpendicular to the plane of the test surface, while for angles of incidence from 45° to 60° the minor axis of the ellipse is perpendicular to this plane. At 45° incidence, the ellipse degenerates to a circle, and in this special case only, Lambert's law is obeyed. For angles of incidence greater than 60°, the curves become quite irregular, and at almost grazing incidence there is a distinct reddish specular component

in the reflected light. An attempt is made to analyse the curves into specular and diffuse components by Barkas's method, but the results suggest that this method is not really applicable in the present instance. 45° appears to be a suitable angle of incidence to adopt in practical gloss determinations.

535.37 2307

Effect of absorption on decay of infra-red sensitive phosphors. ELLICKSON, R. T., AND PARKER, W. L. *Phys. Rev.*, **69**, 534 (*May* 1 *and* 15, 1946).—The usual form for the second-order decay formula is $B = B_0(1 + \alpha t)^{-2}$ where α depends on the intensity of the stimulus, the absorption coefficient and the quantum efficiency. Because of absorption by the phosphor, α has a different value at different depths, and an extended formula is here given which takes account of this. Excellent agreement with the experimental decay curve of a Sr selenide–Sm–Eu phosphor is obtained, allotting empirical values for the absorption coefficients.

535.37 : 621.385.832 2308

Cathodo-luminescence. I. Growth and decay processes. STRANGE, J. W., AND HENDERSON, S. T. *Proc. Phys. Soc., Lond.*, **58**, 369–83 (*July*, 1946).—The active centre theory of luminescence, with certain assumptions, leads to the expectation of exponential growth and decay processes in light emission. Measurement has shown the widespread occurrence of exponential processes, though the details are much more complex than the simple theory would suggest. The effects of changing current density and temperature were examined. The phosphors studied fell into two classes, distinguished mainly by the rates of the processes measured. Some non-exponential processes were found, especially in long time decay, but none were definitely bimolecular.

535.37 : 621.385.832 2309

Cathodo-luminescence. II. Current saturation and voltage effects. STRANGE, J. W., AND HENDERSON, S. T. *Proc. Phys. Soc., Lond.*, **58**, 383–91 (*July*, 1946).—The light output from phosphors under steady electron beams has been measured at constant voltage and varying current density, and "current saturation" has been found to vary greatly in extent for different materials. Similarly the change of light output with varying voltage at constant current density has shown different characteristics for different phosphors, but without the expected variations on changing the current density.

535.37 : 621.385.832 2310

Cathodo-luminescence. III. Discussion of results. STRANGE, J. W., AND HENDERSON, S. T. *Proc. Phys. Soc., Lond.*, **58**, 392–401 (*July*, 1946).—The interpretation of the experimental results in the preceding two papers is attempted, but cannot be adequate without more knowledge about electron absorption in phosphors. Some possibilities are outlined with regard to the mechanism of luminescence. There is some evidence in favour of a new type of voltage absorption law.

535.372 : 549.211 : 535.343.2 *see Abstr.* 2303

535.39 = 4 2311

On the absence of broadening on reflexion of emission rays. Doppler and Compton effects, Descartes' law and surface structure. WOLFERS, F. *C.R. Acad. Sci., Paris*, **222**, 546–8 (*March* 4, 1946) *In French.*—A theoretical discussion, the conclusion being reached that there is no thermal movement perpendicular to the surface of a reflecting medium and that the position of the spectral maximum for a ray is not changed on reflexion. A. H.

535.39 : 535.417 : 535.339.3 2312

Theory of an efficient interference filter. MOONEY, R. L. *J. Opt. Soc. Amer.*, **36**, 256–60 (*May*, 1946).—Calculations show that two or more Fabry–Pérot interferometer units in series, adjusted for different orders of interference, can be made to transmit only a very narrow wavelength band. Theoretical results are given for a filter consisting of two glass slabs, each with two coatings, with an air film between the slabs; the method used is to apply the conditions of continuity of normal induction and tangential force to the electric field at each surface. A graph is given of one particular case, where the transmission is 100% at 500 mμ and falls to 33% at 475 and 525 mμ wavelength. N. C.

535.4 : 537.531 : 548.73 *see Abstr.* 2403

535.417 : 535.339.3 : 535.39 *see Abstr.* 2312

535.42 : 537.531 *see Abstr.* 2341

535.435 2313

Modified Rayleigh scattering in a liquid. RANK, D. H. *J. Opt. Soc. Amer.*, **36**, 299–301 (*May*, 1946).—Using a 21 ft concave grating of resolving power 200 000, with precautions against stray light, the author investigated the light scattered by benzene with incident light of wavelengths 3 650 Å and 4 358 Å. Microphotometer traces of the spectral lines in the scattered light showed additional components, of wavelengths ±·034 Å different from the original components of the 3 650 Å line, and ±·039 Å in the case of the 4 358 Å line. These changes are in good agreement with the theory propounded by Brillouin. N. C.

535.435 : 535.322.4 2314

A photo-electric instrument for light scattering measurements and a differential refractometer. DEBYE, P. P. *J. Appl. Phys.*, **17**, 392–8 (*May*, 1946).—The instrument has been developed for routine measurements of particle sizes and molecular weights of solutions [see Abstr. 2425 (1944)]. The results of its use to determine the viscosity/mol. wt. relation of a series of polyvinyl *n*-butyl ethers in benzene solution are given. The refractometer is used for measuring the difference in refractive index between solvent and solution, and has an accuracy better than 10^{-5}.

535.515 = 4 2315

Effect of reflecting power of mica on its use in quarter wave plates in polarimetric work. RABINOVITCH, J.; COTTON, A. *C.R. Acad. Sci., Paris*, **222**, 650–4 (*March* 18, 1946) *In French.*—Discusses mathematically the order of magnitude of the errors produced by surface reflection when mica sheets are used as quarter-wave plates. Methods of reducing reflection and of minimizing the errors are discussed. A. H.

535.642.1 : 612.843.35 : 612.845.5 2316

Mechanism of colour discrimination and a new type of colour blindness. DE VRIES, H. *Nature, Lond.*, **157**, 804–5 (*June* 15, 1946).—[See Abstr. 1601 (1946)].

535.651 : 535.234 *see Abstr.* 2295

535.8 : 537.363 : 541.18 : 541.133.1 *see Abstr.* 2383

535.81 : 771.351 *see Abstr.* 2424

535.833 2317

Effect of modifying the spherical aberration on the resolution of a lens erecting telescope. RANK, D. H. *J. Opt. Soc. Amer.*, **36**, 302–6 (*May*, 1946).—The spherical aberration in question was known to be produced entirely by the second erecting lens, originally a spherical system. By hand polishing one surface of this lens, removing material from the centre and checking with a Twyman interferometer, it was found possible to improve the performance of the lens to 80% perfection for axial rays. The polishing was quite simple to a skilled operator, and the result was to cure a troublesome flicker which had been a characteristic of the instrument when the eye was moved rapidly over the exit-pupil. N. C.

535.833 : 551.591.1 2318

Atmospheric limitations on the performance of telescopes. HARDY, A. C. *J. Opt. Soc. Amer.*, **36**, 283–7 (*May*, 1946).—This paper gives the relation between aided and unaided vision as influenced by the effect of the atmosphere; the effect of apparent size and the contrast factor are also considered. The magnification necessary to produce a desired gain in range under greatly varying atmospheric conditions is shown graphically. E. G. M.

535.89 : 771.241 = 3 *see Abstr.* 2423

HEAT . THERMODYNAMICS 536

536.2 : 551.482.213 : 621.577 = 3 2319

The temperature equalization in rivers in connection with heat pumps and power plant. GALAVICS, F., AND FEJÉR, G. *Schweiz. Arch. angew. Wiss. Tech.*, **11**, 269–77 (*Sept.*); 302–11 (*Oct.*, 1945) *In German.*—[Abstr. 2175 B (1946)].

536.212.2 : 621.385.13 : 537.311.31.08 *see Abstr.* 2334

536.23 2320

The thermal conductivities of eight common gases between 80° and 380°K. JOHNSTON, H. L., AND GRILLY, E. R. *J. Chem. Phys.*, **14**, 233–8 (*April*, 1946).—Thermal conductivities of O_2, N_2, CO, NO, H_2, He, N_2O, CO_2 and CH_4 have been measured between 80°K and 380°K, with a new cell [Abstr. 2321 (1946)]. Results—which have a precision generally better than 0·1% and are believed to be accurate to ±0·5%—are tabulated. Comparisons with the results of other investigators are also shown in tabular form.

536.23.08 2321

An improved hot wire cell for accurate measurements of thermal conductivities of gases over a wide temperature range. Results with air between 87° and 375°K. TAYLOR, W. J., AND JOHNSTON, H. L. *J. Chem. Phys.*, **14**, 219–33 (*April*, 1946).—The cell is of the potential lead type, and theoretical treatments are given for radiation, end conduction, potential lead conduction, and the "temperature jump" effect. The latter is found to be satisfactorily eliminated by linear extrapolation of reciprocal plots of "apparent conductivities" as a function of pressure. Convection effects are absent at pressures below about 20 cm of Hg. The emissivity from bright Pt was measured, confirming the measurements of Milverton [Abstr. 1212 (1934)]. The thermal conductivity of air was measured at 17 temperatures between 87° and 375°K. The results, which are believed accurate to within ±0·5%, are tabulated and are generally lower than other recent results. A critical analysis of possible sources of error is made.

536.241 2322

The transient flow of heat through a two-layer wall. GRIFFITH, M. V., AND HORTON, G. K. *Proc. Phys. Soc., Lond.*, **58**, 481–7 (*July*, 1946).—The sudden introduction of a high temperature source of heat into a room is idealized by supposing that the walls absorb a constant uniform flux of heat. Formulae for the temperature distribution after various times are derived on the hypothesis that a wall is of infinite extent and comprises a uniform finite layer superimposed on an indefinitely thick base. The factors which determine the rate of rise of the wall-surface temperature are particularly studied.

536.33 : 535.341 2323

Some observations upon the effect of colour on the absorption and emission of radiation by a textile fabric. REES, W. H., AND OGDEN, L. W. *J. Text. Inst., Manchr*, **37**, T113–20 (*April*, 1946).—An investigation of the effect of the colour of a cotton fabric upon (*a*) the absorption of solar radiation (as simulated by a high-intensity carbon arc) and (*b*) the emission of long-wave radiation (corresponding to body temperature) by the fabric. It was found that whereas the colour greatly affected (*a*) its effect on (*b*) was negligible. J. W. T. W.

536.413 : 541.64 2324

Thermal expansion and second-order transition effects in high polymers. III. Time effects. SPENCER, R. S., AND BOYER, R. F. *J. Appl. Phys.*, **17**, 398–404 (May, 1946). [See Abstr. 480 (1946)]. It has been suggested that the so-called 2nd-order transition in high polymers is not an equilibrium phenomenon, i.e. a true thermodynamic singularity, but rather a rate effect. Confirmation of this point of view has been obtained by determining the equilibrium volume-temperature curve of polystyrene which exhibits no transition within the range 20°–140°C, whereas the same material shows a transition at about 82°C for rates of heating usual in thermal expansion measurements. Two facts appear in agreement with the viscous flow interpretation of the thermal expansion process: First, two mechanisms were found to operate, at markedly different rates. One gave almost instantaneous expansion, even at room temperature, whereas the other was quite temperature-dependent in this region, being extremely slow at room temperature. Second, the activation energy for the slower mechanism was found to be of the order of magnitude of that for viscous flow, considerably lower than the activation energy for rubber-like elasticity. Volume-temperature curves at finite rates of heating are discussed.

536.421 : 678 2325

Crystallization of unvulcanized rubber at different temperatures. WOOD, L. A., AND BEKKEDAHL, N. *J. Appl. Phys.*, **17**, 362–75 (*May*, 1946).—The crystallization and melting of unvulcanized natural rubber in the unstretched state have been investigated

at different temperatures. Change of volume has been used as a quantitative measure of the extent of crystallization. A bibliography of 78 entries is included.

536.48 : 537.312.62 2326

Zero point diffusion in liquid helium. II. DAUNT, J. G., AND MENDELSSOHN, K. *Nature, Lond.*, **157**, 839–40 (*June* 22, 1946).—An experiment is described which demonstrates that the frictionless transfer of superfluid liquid helium can take place even without gravitational acceleration. The momentum is evidently supplied by zero-point energy. This is analogous to current flow in a superconductor without applied e.m.f. [see Abstr. 1309 (1946)].

536.531 2327

Application of platinum resistance thermometry to some industrial physicochemical problems. STULL, D. R. *Industr. Engng Chem.* (*Analyt. Edit.*) **18**, 234–42 (*April*, 1946).—Platinum resistance thermometry is discussed in some detail, with mention of new techniques for construction of these thermometers and their convenient size. An automatic recorder facilitates their use. The cryoscopic method of determining the purity of a compound using Pt resistance thermometers is presented, together with the assumptions and limitations of the method. A modified ebulliometer and a new type of boiling range apparatus incorporating Pt resistance thermometers are presented and compared with the standard A.S.T.M. method. The increased accuracy resulting from the use of Pt resistance thermometers as well as the automatic recording feature fits these three applications well for industrial use.

536.532.087.4 : 621.317.39.087.4 2328

Electronically balanced recorder for flight testing and spectroscopy. WILLIAMS, A. J., JR., CLARK, W. R., AND TARPLEY, R. E. *Trans. Amer. Inst. Elect. Engrs*, **65**, 205–8 (*June*, 1946).—[Abstr. 1836 B (1946)].

536.584.3 2329

Note on the "CO_2-point" in thermometry. KANNULUIK, W. G., AND LAW, P. G. *J. Sci. Instrum.*, **23**, 154–5 (*July*, 1946).—Some practical information is given on the best method of maintaining a fairly large object (4½ in long) at the "CO_2-point" temperature (−78·5°C). A wet mixture of "dry-ice" and alcohol was used in a lagged glass cylinder.

536.7 : 531.19 : 541.61 2330

Statistical thermodynamics of mixtures. MILLER, A. R. *Nature, Lond.*, **157**, 842–3 (*June* 22, 1946).

536.71: 531.19 : 532.7 *see Abstr.* 2280

536.77 : 539.132 *see Abstr.* 2355

ELECTRICITY . MAGNETISM . X-RAYS CHARGED PARTICLES 537/538

537.122 : 530.145 *see Abstr.* 2255, 2256

537.221 : 678 : 539.42.096 *see Abstr.* 2376

537.226.2 : 621.3.011.5 : 621.315.616.96 2331

Dielectric behaviour of "polythene" at very high frequencies. POWLES, J. G., AND OAKES, W. G. *Nature, Lond.*, **157**, 840–1 (*June* 22, 1946).—[Abstr. 2039 B (1946)].

537.24 : 537.568 = 4 2332

Electrification of particles suspended in a gas by ions produced by X-rays or radioactive substances. OUANG, T.-T. *Ann. Phys., Paris*, **16**, 47–144 (*July–Sept.*, 1941) *In French.*—The equilibrium between large and small ions in a gas, the large ions being produced on smoke particles and the small ions by means of Po or X-rays, has been investigated. When equilibrium is established between the two types in the presence of neutral particles, a definite fraction of the neutral particles is converted into large ions of each sign. This fraction depends on the size of the particles, but is independent of the concentration of small ions if this is large. The number of large negative ions is always greater than the number of large positive ones, however large the particles may be, and the number of large ions is independent of the presence in the gas of particles previously charged. An application of the theory of Langevin gives the coefficient of formation of large ions. The different results obtained by various workers on large ions in the atmosphere can be explained on the basis of the theory. There appears to be a favoured radius for ions produced on smoke particles or in the atmosphere. A. J. M.

537.291 2333

On the theory of the electrostatic beta-particle energy-spectrograph. IV. ROGERS, F. T., JR. *Phys. Rev.*, **69**, 537 (*May* 1 *and* 15, 1946).—One of the approximations used in an earlier calculation [Abstr. 2851 (1943)] is examined and shown to be justified in a first-order theory.

537.311.31.08 : 621.385.13 : 536.212.2 2334

Methods of minimizing lead loss in emissivity and resistivity determinations. MALTER, L., AND LANGMUIR, D. B. *J. Appl. Phys.*, **17**, 456–7 (*June*, 1946).—Two means are described for minimizing the effects of lead loss in determining the electrical properties of thin filaments as a function of temperature. In both cases the filaments are supported at the mid-points of filamentary U's. In one case the U's are made of finer wire than the main filament so that lead loss is reduced. In the other case, alternating current is passed through the U's so that the temperature of the main filament is maintained uniform down to its points of support.

537.311.33 : 548.7 : 541.67 : 621.315.59 2335

The basic principles of semi-conductors. SEITZ, F. *J. Appl. Phys.*, **16**, 553–63 (*Oct.*, 1945).—A review is given of typical deviations from ordinary valence rules by alloys and inorganic compounds. The effect on the electrical properties of a compound of a deviation from stoichiometric proportions is discussed. The value of the information obtained from electrical measurements is illustrated by a discussion of the properties of several semi-conducting compounds.

537.311.33 : 541.67 : 621.315.59 2336

The electrical properties of semi-conductors. MAURER, R. J. *J. Appl. Phys.*, **16**, 563–70 (*Oct.*, 1945).—The electrical properties of semi-conductors are briefly reviewed. The information concerning the structure of these materials which is obtained by electrical measurements is discussed. The most important of the physical-chemical methods available for the investigation of deviations from stoichiometric

proportions in semi-conducting compounds are illustrated by a discussion of several typical examples.

537.312 : 621.383.8 2337

Photovoltaic effects exhibited in high-resistance semi-conducting films. STARKIEWICZ, J., SOSNOWSKI, L., AND SIMPSON, O. *Nature, Lond.*, **158**, 28 (*July* 6, 1946).—Layers of PbS about 1 micron thick deposited on glass between graphite electrodes exhibit a photovoltaic e.m.f. as high as 2 V when illuminated with infra-red radiation of 1–3·5 microns wavelength. The resistance is a few megohms. The activation treatment consists in passing a current through the film at a temperature sufficiently high to ensure mobility of oxygen ions. The direction of the resulting photo-e.m.f. is in the opposite sense to the activating current. The theory of the action of the film and the activation is briefly discussed.

537.312.5 : 577.1 : 539.13 *see Abstr.* 2352

537.312.62 : 536.48 *see Abstr.* 2326

537.363 : 541.18 : 535.8 : 541.133.1 *see Abstr.* 2383

537.363 : 541.18 : 541.133.1 *see Abstr.* 2381, 2382, 2384

537.523.4 2338

Some aspects of Meek's sparking equation. FISHER, L. H. *Phys. Rev.*, **69**, 530 (*May* 1 *and* 15, 1946).

537.523.4.029.64 : 621.3.015.5.029.64 2339

Lowering of electrical breakdown field strength at microwave frequencies due to externally-applied magnetic field. POSIN, D. Q. *Phys. Rev.*, **69**, 541 (*May* 1 *and* 15, 1946).

537.531 : 535.339 2340

A new type of focusing X-ray monochromator. HALL, W. H. *Nature, Lond.*, **157**, 842 (*June* 22, 1946).—A single texture rolled Cu strip is used, which has a very high degree of preferred orientation. The strip can be curved and ground much more easily than crystals, and is much more robust.

537.531 : 535.4 : 548.73 *see Abstr.* 2403

537.531 : 535.42 2341

The integral breadths of Debye–Scherrer lines produced by divergent X-rays. WILSON, A. J. C. *Proc. Phys. Soc., Lond.*, **58**, 401–7 (*July*, 1946).—Divergence of the incident X-ray beam produces appreciable phase differences between different parts of a crystal, even in the size range for which line broadening occurs. The broadening due to this phase difference is calculated. It is ordinarily negligible, as the increase in the width of the line is of the order of $1{\cdot}6\,t\cos\theta$, where t^3 is the volume of a crystal and θ is the Bragg angle. The special case of film and source equidistant from the crystal is investigated in greater detail.

537.533 : 535.215 *see Abstr.* 2292

537.533 : 535.215.2 *see Abstr.* 2293

537.533.72 : 539.165.08 2342

Focusing of electrons in two dimensions by an inhomogeneous magnetic field. SIEGBAHN, K., AND SVARTHOLM, N. *Nature, Lond.*, **157**, 872–3 (*June* 29, 1946).—The theory of focusing by a ring-shaped magnetic field, somewhat similar to a betatron or α-ray spectrograph field, is outlined. A β-ray spectrograph of radius 12·5 cm has been constructed, with pole faces ground empirically, and its focusing properties shown by a photograph.

537.533.72 : 621.385.833 2343

The variation of resolution with voltage in the magnetic electron microscope. COSSLETT, V. E. *Proc. Phys. Soc., Lond.*, **58**, 443–55 (*July*, 1946).—The spherical and chromatic aberrations, the diffraction error and the total aberration of a magnetic electron lens are discussed, as regards variation with voltage, on the basis of theoretical data for the dependence of the aberration coefficients and focal length on lens power. The total aberration shows a minimum value at a given value of the lens power, in a lens of fixed aperture and maximum field strength. The minimum does not occur at either the minimum focal length or the minimum of the spherical aberration coefficient, but at intermediate values of these quantities. When the maximum field is 10 000 oersteds, the minimum resolution is 10–12 Å at an accelerating voltage of 50 kV, the corresponding focal length being 2 mm. If the aperture is adjusted, in a lens of otherwise fixed dimensions, to the optimum value at each voltage, the total aberration varies very little at high voltages. If the lens dimensions are appropriately increased as well as the aperture, the total aberration can be progressively reduced with increasing voltage.

537.541 2344

High-frequency discharge as an ion source. THONEMANN, P. C. *Nature, Lond.*, **158**, 61 (*July* 13, 1946).—Ions from a high-frequency discharge generated by a 5-m oscillator in a 2 litre Pyrex flask filled with gas at 10^{-3} mm Hg pressure can be extracted by a constant potential as high as 20 kV, which will not by itself maintain a discharge at this pressure. A diagram shows the arrangement of electrodes. A current of 12 mA of H^+ ions was obtained at 20 kV.

537.564 2345

A direct measurement of the efficiency of the Penning-effect. SCHUT, T. G., AND SMIT, J. A. *Physica, 's Grav.*, **10**, 440–4 (*June*, 1943).—A description of an elementary method for the determination of the effective cross-section for ionization of gas atoms by metastable atoms, together with some preliminary results.

537.568 : 537.24 = 4 *see Abstr.* 2332

537.581 = 4 2346

Electronic emission of tungsten-caesium and tungsten-thorium cathodes. BIGUENET, C. *Le Vide*, **1**, 13–20 (*Jan.*); 54–60 (*March*, 1946) *In French.*—A review dealing with the theory of the adsorption of Cs and Th on W, and practical methods of producing thoriated W filaments. A. J. M.

537.583 : 621.385.13.032.216 : 548.73 *see Abstr.* 2404

537.591.15 2347

Cosmic ray showers. CLAY, J. *Proc. Ned. Akad. Wet.*, **44** (*No.* 8) 888–96 (1941).—Experiments on the penetration and spreading of showers are summarized. The divergence and penetrating powers of showers with small spreading in the first maximum (under 1·5 cm Pb) and the second maximum (under 25 cm Pb) have been compared. In the second case the spreading is greater and the penetrating power is less. The number of showers of mesons and electrons occurring under thick layers of air, H_2O, Al, Fe and Pb has been determined. The number decreases with increasing atomic number. Meson showers have a

greater spreading than electron showers. [See also Abstr. 1663–5 (1946)]. A. J. M.

537.591.5 2348

The east-west asymmetry of cosmic radiation at a geomagnetic latitude of 28° 31′ and an estimation of the difference of the exponents of the absorption law for the polar and the equatorial regions. OSTER, F., CH'U, S.-L., AND LÜ, L.-Y. *Phys. Rev.*, **69**, 531 (*May* 1 *and* 15, 1946).—The asymmetry measured at Peiping, China, has a maximum value at a zenith angle of 50°. The results are applied to obtain an estimate of 0·12 for difference in values of n in the absorption law $I = A/h^n$ for poles and equator [see Abstr. 671 (1939)].

537.591.5 2349

Tidal effects on the production of mesons in the atmosphere. MAILVAGANAM, A. W. *Proc. Phys. Soc., Lond.*, **58**, 468–71 (*July*, 1946).—The theory of forced oscillations, magnified by resonance, of the earth's atmosphere with a period of 12 solar hours, as worked out by Pekeris [Abstr. 3211 (1939)], is applied to calculate the amplitude of oscillation of the layer in the atmosphere in which mesons are produced by primary incident particles. The calculations show that, on account of these oscillations and of the finite life-time of mesons, a semi-diurnal variation in meson intensity with an amplitude of the order of 0·14% may be expected.

538.56 : 530.12 2350

Relative nature of electromagnetic radiation. SOH, H.-P., WANG, M.-H., AND KIANG, S.-C. *Nature, Lond.*, **157**, 809 (*June* 15, 1946).—Transformation coefficients are obtained between two systems, one at rest and the other in accelerated motion. These are applied to show that the field due to a rest charge observed by an accelerated observer is identical with that due to an accelerated charge observed by an observer at rest.

538.569.4 : 539.13 : 535.343.4–14 *see Abstr.* 2305

538.569.4.029.64 : 539.13 2351

The absorption of microwaves by gases. HERSHBERGER, W. D. *J. Appl. Phys.*, **17**, 495–500 (*June*, 1946).—Fourteen additional gases have been found whose absorption is comparable to that of NH_3, e.g. dimethyl ether, a variety of amines and alkyl halides. The absorption coefficient and dielectric constant of these gases taken at 1·25 cm at room temperature and a pressure of one atmosphere are given. The maximum absorption coefficient frequency may be inferred from the curve: absorption coefficient v. pressure. Data on the absorption of several gas mixtures are given. Possible molecular mechanisms adequate to account for the large absorptions observed are discussed together with the conclusions reached.

RADIOACTIVITY . MOLECULES . ATOMS 539

539.13 : 537.312.5 : 577.1 2352

Internal photo-electric effect and band spectra in proteins. SZENT-GYÖRGYI, A. *Nature, Lond.*, **157**, 875 (*June* 29, 1946).—It is suggested that the electron structures of the outer atoms of a protein molecule are shared by the molecule as a whole, and in support of this hypothesis it is reported that the electric conductivity of coloured protein films has been observed to be increased several hundred per cent by illumination.

539.13 : 538.569.4 : 535.343.4–14 *see Abstr.* 2305

539.13 : 538.569.4.029.64 *see Abstr.* 2351

539.132 2353

On the force constants of the XY_2 molecule. SIMPSON, D. M., GLOCKLER, G., AND TUNG, J. Y. *J. Chem. Phys.*, **14**, 294 (*April*, 1946).—[See Abstr. 540 (1946)].

539.132 : 535.33 2354

New regularities in vibrational spectra. GUGGENHEIMER, K. M. *Proc. Phys. Soc., Lond.*, **58**, 456–68 (*July*, 1946).—The frequencies of about 150 diatomic molecules are expressed as functions of the equilibrium distance and of the numbers of electrons in the outer shells of both atoms. The frequencies are calculated for homopolar molecules with single bonds, with multiple bonds and for molecules with strong polarity. The contributions of s- and p-electrons to the force constant are practically equal, and the same parameters are valid for all periods of the periodic system. The theoretical implications are discussed.

539.132 : 536.77 2355

Energy levels and thermodynamic functions for molecules with internal rotation. II. Unsymmetrical tops attached to a rigid frame. PITZER, K. S. *J. Chem. Phys.*, **14**, 239–43 (*April*, 1946).—Formulae are derived which make the tables and equations of the first paper [Abstr. 2889 (1942)] applicable to this more general class of molecules. Additional approximations are involved and these are examined carefully.

539.133 : 535.343.3 2356

The non-planar vibrations of benzene. MILLER, F. A., AND CRAWFORD, B. L., JR. *J. Chem. Phys.*, **14**, 282–92 (*April*, 1946).—A thorough normal co-ordinate treatment has been carried out for the non-planar vibrations of benzene and its deuterium derivatives, and has furnished strong independent support for those advanced by Pitzer and Scott [Abstr. 2191 (1943)]. Values for all 8 force constants of the complete harmonic potential function were found. For 4 of the constants 2 sets of values were obtained, both of which are physically reasonable and which reproduce the frequencies equally well. The force constants were then used to calculate frequencies for the various deuterobenzenes. Nearly 60 such frequencies were evaluated, of which about 40 could be checked against experiment [see Abstr. 2304 (1946)]. With 4 exceptions the errors are less than 1·5%. Lastly, certain valence-force constants pertaining to hydrogen vibrations have been determined.

539.133 : 541.57 2357

Electric induction in molecules and the polarity of the C–H bond. GENT, W. L. G. *Nature, Lond.*, **158**, 27 (*July* 6, 1946).—[See Abstr. 829 (1938)].

539.15 : 535.338.1 2358

Remarks on the fine structure of "positronium." BECK, G. *Phys. Rev.*, **69**, 532 (*May* 1 *and* 15, 1946).—[See Abstr. 1107 (1946)].

539.152.1 2359

A spherical shell nuclear model. WILSON, H. A. *Phys. Rev.*, **69**, 538 (*May* 1 *and* 15, 1946)].

539.153.4 : 535.14 : 530.14 = 4 *see Abstr.* 2252

539.162 2360

Radii of the nuclei of natural α-emitters. PRESTON, M. A. *Phys. Rev.*, **69**, 535 (*May* 1 *and* 15, 1946).—New values for the radii and depth of the potential pole of 17 radioactive nuclei have been worked out on the basis of improved theory and corrected experimental values. These are given in tabular form and compared with Bethe's values [Abstr. 3308 (1937)].

539.162 = 4 2361

Systematic time distribution of alpha disintegrations. THIBAUD, J. *Ann. Phys., Paris*, **15**, 225–57 (*April–June*, 1941) *In French.*—In examining the time interval between successive α-particles emitted from a Po source it appears that these intervals group themselves so that some are much more probable than others. The variation from the random distribution has a strict periodicity whose amplitude is much larger than can be explained merely by statistical fluctuations. The statistical problems involved are examined by many different methods all leading to the same general conclusion. W. E. D.

539.163.4 2362

Synthesis by nuclear recoil. REID, A. F. *Phys. Rev.*, **69**, 530–1 (*May* 1 *and* 15, 1946).—Two samples of iodine, one of them dissolved in pentane, were irradiated simultaneously with slow neutrons, the second sample then being dissolved in pentane also. Any amyl iodide in the two solutions was then separated (using inactive amyl iodide as carrier). It was found that, 38 ± 3% of the active I^{128} in the first sample was present as amyl iodide, but less than ½% in the second sample. The nuclear recoil in the reaction $I^{127} + n \rightarrow I^{128} + \gamma$ is thus effective in producing the reaction $C_5H_{12} + I^{128} \rightarrow C_5H_{11}I^{128} + H$, and synthesizing a strongly active compound.

539.165.08 : 537.533.72 *see Abstr.* 2342

539.165.2 2363

β-ray spectrum of K^{40}. DŽELEPOW, B., KOPJOVA, M., AND VOROBJOV, E. *Phys. Rev.*, **69**, 538–9 (*May* 1 *and* 15, 1946).—A special spectrometer was used with six sources and one receiving counter. Each source had a counter near it, and coincidences between the central counter and each of the outer ones were observed for different magnetic fields. The resulting spectrum was of similar shape to those of allowed transmutations, the upper limit being at 1 350 ± 50 ekV.

539.166.2 2364

Angular correlation of successive γ-rays. GOERTZEL, G., AND LOWEN, I. S. *Phys. Rev.*, **69**, 533–4 (*May* 1 *and* 15, 1946).—Earlier calculations [Abstr. 2778 (1940)] have been extended to take into account the effect of reorientation of the nuclear angular momentum caused by the interaction of the nuclear magnetic moment with the moment of the external electrons. Specific calculations with the derived formulae indicate that, as the hyperfine structure separation of the intermediate level increases, the angular correlation grows less [see Abstr. 1168 (1943)]. Angular correlation of internal conversion β-rays is also to be expected.

539.167.3 = 3. 2365

Isotopes S^{37} and P^{34} produced by irradiation of chlorine with rapid neutrons. BLEULER, E., AND ZÜNTI, W. *Helv. Phys. Acta*, **19** (*No.* 3) 137–66 (1946) *In German.*—Irradiation of Cl_2 with fast neutrons gives rise to the isotope S^{37} with a half-life of 5 min. The complex β-spectrum consists of two groups of maximum energy 4·3 and 1·6 eMV respectively. A previously recorded activity of half-life 12·4 sec is due to P^{34}, whose β-ray spectrum has energy maxima of 5·1 and 3·2 eMV. The apparatus used is fully described, and sources of error are discussed. A. J. M.

STRUCTURE OF SOLIDS 539.2

539.21 : 539.4.016 : 669.112 2366

On the decarburization of steel and related questions. SNOEK, J. L. *Physica, 's Grav.*, **8**, 734–44 (*July*, 1941).—The formation of a sharply defined layer of ferrite on the surface of steel annealed in moist H_2 at 700–800°C is explained by the fact that the diffusivity of C in α Fe is about 2 600 times greater than in γ Fe. As soon as a C atom diffuses from a γ crystal into an α crystal it is removed to the surface, and there is no chance for a region of mixed crystals to form. Iron purified in this way contains much less than 0·001% C, an amount readily detectable by its elastic after effect [see Abstr. 2373 (1946)]. Such purified Fe shows strain hardening, in contrast with ordinarily pure Fe (~0·003% C), which shows strain softening. A. J. C. W.

539.215.2 : 771.534.544 *see Abstr.* 2426

539.217.1 : 532.66 = 4 *see Abstr.* 2277

539.217.5 : 541.64 : 533.15 *see Abstr.* 2282

ELASTICITY . STRENGTH . RHEOLOGY 539.3/.8

539.31 : 678 2367

Significance of the equation of state for rubber. GUTH, E., WACK, P. E., AND ANTHONY, R. L. *J. Appl. Phys.*, **17**, 347–51 (*May*, 1946).—The physical significance of stress-strain curves and of isometrics obtained by the relaxation method is discussed and clarified. Stress-strain curves taken at various temperatures give the correct dependence of stress upon temperature if they are taken sufficiently fast so that stress relaxation does not mask the temperature dependence. Isometrics obtained after previous relaxation of the sample are shown to depend upon duration and temperature of the relaxation by a numerical factor only. The basis for this behaviour is the factorization of the stress into a factor depending upon extension and temperature only which corresponds to the equation of state, and another factor depending upon the temperature T^* and the duration of the relaxation process. For simple stress relaxation, the same factorization holds with T^* equal to T. A general theory is formulated for time dependent elastic phenomena by generalizing Boltzmann's theory. The theory explains why factorization does not hold for creep, in agreement with experiment.

539.312 : 534.372 2368

Dynamic characteristics of rubber supports from vibration table data. CHILTON, E. G. *J. Appl. Phys.*, **17**, 492–5 (*June*, 1946).—Measurements of the vibration of a free mass which is isolated by a rubber support from a surface vibrating at constant amplitude

permit calculations of the dynamic characteristics of the support. This method permits high loadings and the application of considerable force.

539.32 2369

Elastic properties of cork. I. Stress relaxation of compressed cork. DART, S. L., AND GUTH, E. *J. Appl. Phys.*, **17**, 314–18 (*May*, 1946).—Stress relaxation was studied at various degrees of compression and at temperatures ranging from 30°C to 200°C. The stress is a product of two functions: the first essentially identical with the *S*-shaped load-compression curve of cork and independent of time; the second a linear function of log t and independent of compression. The linear stress/log time curve is found to persist over a wide range of times and to continue until the stress has decayed to zero at the higher temperatures. The decay time as obtained either by actual experiment or by extrapolation is shown as a function of temperature. This gives a fairly complete picture of the stress-time-temperature behaviour of cork under compression.

539.32 : 553.621 : 548.0 *see Abstr.* 2400

539.37 2370

Nonlinear theory of elasticity with small deformations. STERNBERG, E. *J. Appl. Mech.*, **13**, *A*53–60 (*March*, 1946).—Previous investigations of non-linear theory of elasticity have been concerned largely with the problem of finite deformations. In this paper the assumption of "infinitesimal" deformations is retained, whereas Hooke's law is replaced by a general 2nd-order approximation of non-linear stress-strain laws. Applications to uniaxial tension and compression as well as torsion of right circular cylinders are considered in detail. The results obtained indicate 2nd-order effects which were previously unnoticed because of the early linearization of the extended stress-strain relations.

539.373 : 678 2371

The theory of permanent set at elevated temperatures in natural and synthetic rubber vulcanizates. ANDREWS, R. D., TOBOLSKY, A. V., AND HANSON, E. E. *J. Appl. Phys.*, **17**, 352–61 (*May*, 1946).—A molecular theory is developed to describe quantitatively the permanent set taking place in thin samples of vulcanized natural and synthetic rubbers held at constant extension at elevated temperatures. Permanent set is considered to be the result of the formation, through the action of molecular scission and cross-linking reactions, of a dual molecular network in the rubber sample, in which the network chains are of two types: chains which are at equilibrium when the sample is at its unstretched length, and chains which are at equilibrium when the sample is at its stretched length. According to the theory the amount of permanent set in a rubber sample is a function of only two quantities: the relative ratio of the number of chains of the two types, and the elongation at which the sample was held. Experimental data on permanent set for various rubber types and under different conditions are presented and are shown to be in good agreement with the theory.

539.374 : 541.24 2372

Theory and application of the parallel plate plastometer. DIENES, G. J., AND KLEMM, H. F. *J. Appl. Phys.*, **17**, 458–71 (*June*, 1946).—A method has been established for the measurement of the viscosity of high polymers at low rates of shear in the range 10^4–10^9 poises using a parallel plate plastometer. This is based on a mathematical criterion for separating the viscous portion of the deformation from the "elastic" and "delayed elastic" components. Experimentally, the plate separation is measured at a given temperature as a function of time. The theory furnishes a relation, which is also the criterion for predominantly viscous deformation, between viscosity, plate separation, applied load and time. The method has been applied to polyethylene and vinyl chloride-acetate resin compounds, for which log viscosity $\propto$ (absolute temperature)$^{-1}$ over the temperature range studied. For polyethylene resins and polyethylene resin-paraffin wax mixtures, log viscosity $\propto$ (weight average molecular weight)$^{\frac{1}{2}}$. Accordingly, the parallel plate plastometer offers promising possibilities for the empirical determination of the weight average molecular weight of these materials. Data are also presented on plasticized vinyl chloride-acetate resin systems which point to a close parallel between the effects of increasing temperature and increasing plasticizer concentration.

539.389.3 : 669.112 2373

Effect of small quantities of carbon and nitrogen on the elastic and plastic properties of iron. SNOEK, J. L. *Physica, 's Grav.*, **8**, 711–33 (*July*, 1941).—The elastic after-effect on Fe was investigated by means of a torsion pendulum suspended by an Fe wire, or of a compound pendulum suspended by an Fe strip. Damping other than that due to elastic after-effect was avoided by enclosing the apparatus in a vacuum or an atmosphere of hydrogen, and applying a constant magnetic field to suppress magnetic hysteresis effects. The enclosure was made of silica so that the suspension could be heat treated without disturbing it. For "pure" Fe (carbon removed by annealing in moist H_2 at 700–800°C) the logarithmic decrement is practically constant in the temperature range $-50°$ to $+100$°C. Iron containing interstitial C or N shows a maximum in the decrement at about room temperature, the values being indistinguishable from those for pure Fe towards the ends of the temperature range. The height of the maximum depends on the amount of C or N present, and this can be adjusted conveniently by annealing at 600°C in H_2 containing a known percentage of CO or NH_3. The shape of the curve can be predicted from previous measurements on magnetic after-effect [Abstr. 1818 (1939)], and the agreement is good. Measurements were also made on cold-worked samples containing known amounts of C or N. The curves are more complex, and the maximum is shifted to higher temperatures ($\sim$200°C). The results are discussed in the light of Gorski's theory that C and N atoms tend to migrate from regions of compression to regions of tension.

A. J. C. W.

539.389.3 : 669.112 2374

Theory of the elastic after-effect and the diffusion of carbon in alpha-iron. POLDER, D. *Philips Res. Rep.*, **1**, 5–12 (*Oct.*, 1945).—Snoek's theory [Abstr. 2373 (1946)] is worked out in more detail. The effect is calculated when a single crystal is submitted to a simple stress in an arbitrary direction; agreement with

experiment is satisfactory. From the time of relaxation, by means of which the relaxation phenomena in a state of alternating stress can be described, the coefficient of diffusion of carbon in α-Fe is calculated and is compared with that of γ-Fe.

539.389.4 2375

A mechanical counterpart to the Rayleigh law of ferromagnetic hysteresis. SNOEK, J. L. *Physica, 's Grav.*, **8**, 745–7 (*July*, 1941).—The elastic hysteresis of an annealed Ni wire was measured by observing torsional oscillations in the absence of a magnetic field. The damping was found to increase linearly with the amplitude, but this effect disappeared when a magnetic field of 300 oersted was applied to the wire. The part of the damping due to hysteresis is strongly temperature-dependent.

539.4.016 : 669.112 : 539.21 *see Abstr.* 2366

539.42 : 532.123 *see Abstr.* 2271, 2272

539.42.096 : 537.221 : 678 2376

Electrostatic and tensile properties of rubber and GR-S at elevated temperatures. HAVENHILL, R. S., O'BRIEN, H. C., AND RANKIN, J. J. *J. Appl. Phys.*, **17**, 338–46 (*May*, 1946).—This paper describes a new apparatus for measuring electrostatic contact potentials on various materials at elevated temperatures. The electrostatic charge acquired by a steel ball rolling down the surface of a rubber test specimen on a heated inclined plane is measured. The contact potentials of both rubber and GR-S was found to become highly negative at high temperatures. This apparent "boiling off" of electrons and resultant disruption of electrostatic attractive forces within the material is much greater for GR-S than for rubber and probably accounts for the much greater decrease in tensile strength of GR-S over rubber at high temperatures, and is further confirmation of the electrostatic contact potential theory of reinforcement. By the further application of this theory suitably dispersed compounding materials, which are in effect highly positive at elevated temperatures, such as certain proteins, finely divided silica and sodium silicate, have been found to increase substantially the hot tensile strengths of GR-S compounds.

539.431 2377

Fatigue failure of rayon tire cord. WALLER, R. C., AND ROSEVEARE, W. E. *J. Appl. Phys.*, **17**, 482–91 (*June*, 1946).—Tyre-cord fatigue tests are characterized and interpreted in terms of the following parameters: magnitude and frequency of the cyclic stroke, average load, minimum load, temperature and humidity. By varying one test parameter at a time, it is shown that the effects of creep and degradation are minimized by using a high frequency and a high stroke. The relative rating of two samples of rayon depends on the parameters of the test and on the modulus and twist structure of the samples. Fatigue breakdown is interpreted in terms of progressive fracture under localized strains occurring at the peak stress of the cycle. A comparison of the fatigue behaviour of rubbers, metals and tyre cord suggests they may all involve the same basic process of crack growth.

539.501 2378

The general relations for flow in solids and their application to the plastic behavior of tire cords. LYONS, W. J. *J. Appl. Phys.*, **17**, 472–82 (*June*, 1946).—Numerous researches on metals, rocks, glass, rubber and textiles show that what may be regarded as *normal* creep in amorphous and polycrystalline solids conforms to the general relation $\varepsilon = \varepsilon_1 + at + b \log t$, where ε is the total strain at time t, ε_1 is a parameter interpretable as the approximate initial strain, and a, b are other parameters. A special form of this equation, having $a = 0$, has been frequently applied. For normal relaxation the relation $\sigma = \sigma_1 - \beta \log t$, has been established where σ is the stress at time t, σ_1 is the stress at unit time, and β is a parameter. A theoretical foundation for both equations is provided by the reaction-rate theory of plastic flow. Observations in the present study indicate that creep extension in cotton and rayon tyre cords over prolonged periods of time follows the above creep equation, and, in general, is not adequately represented by an equation omitting the term at. From the presence of this term in the equation, the existence of a component of the viscous type in tyre cord growth is deduced. The pattern of creep recovery in cotton tyre cord appears to be set by the behaviour of the cord in creep extension.

539.61 : 678 2379

Tackiness of GR-S and other elastomers. BUSSE, W. F., LAMBERT, J. M., AND VERDERY, R. B. *J. Appl. Phys.*, **17**, 376–85 (*May*, 1946).

539.893 2380

Recent work in the field of high pressures. BRIDGMAN, P. W. *Rev. Mod. Phys.*, **18**, 1–93 (*Jan.*, 1946).—A comprehensive review covering the years 1930–45. In all, 674 references are listed, and the work separated into the following sections: technique; mechanical effects of pressure, of which the volumetric effects are the most important, because most simple, including here phase changes; thermal, magnetic, electrical and optical effects; chemical and biological effects.

PHYSICAL CHEMISTRY 541

REACTION KINETICS 541.121/.128

541.124 : 542.952 : 541.182.4 *see Abstr.* 2388

ELECTROCHEMISTRY 541.13

541.133.1 : 541.18 : 537.363 2381

Electrophoresis by the moving boundary method. A theoretical and experimental study. I. SVENSSON, H. *Ark. Kemi Min. Geol.*, **22 A** (*No.* 2) *Paper* 10, 156 *pp.* (1946).—A general theory of electrical migration is given, the only assumptions being that of sharp boundaries. With n ion species present in the system, an originally sharp boundary between two solutions of arbitrary composition will split into $n - 1$ boundaries: one resting, and $n - 2$ moving. The resting boundary is identical with the well-known δ or ε boundary. The boundaries are characterized by the so-called mobilities U′ and U″, one calculated from

the conductivity on the anodic, the other from that on the cathodic side. The condition for obtaining a boundary with the mobility of a certain ion is the absence of this ion in one of the original solutions. Exact information on the conductivity to be used for calculating the field strength is given. The theory is claimed to be valid for ordinary and for colloid ions. An expression for the conductivity change at a moving boundary is derived, and the influence of different experimental conditions on the boundary anomalies are discussed in detail. The specific charge of the colloid and the mobilities of the buffer ions exert a great influence. With decreasing mobilities of the buffer ions, the boundary anomalies gradually diminish, and, if a buffer ion with the same mobility as the colloid can be found, the anomalies disappear. A consideration of the changes in ionic concentrations and refractive index at moving boundaries shows that all ions present change their concentrations at every boundary and that the refractive index increment at a moving colloid boundary, contrary to the general view, is not due to the colloid alone. The possibilities of choosing such experimental conditions that this ideal state of affairs is approximated to are investigated and discussed. The magnitude of the δ gradient is derived on the assumption that the two original solutions are in complete Donnan equilibrium with each other. Other sources of error, such as electrode reactions, electro-osmosis and convections are briefly discussed. [See also Abstr. 2382 (1946)]. N. M. B.

541.133.1 : 537.363 : 541.18 2382

Electrophoresis by the moving boundary method. A theoretical and experimental study. II. SVENSSON, H. *Ark. Kemi Min. Geol.*, **22 A** (*No.* 2) *Paper* 10, 156 *pp.* (1946).—[See Abstr. 2381 (1946)]. A description of the Tiselius apparatus is given. This has been improved by the introduction of modified cells and electrode tubes to give better insulation, and reconstructed electrodes to increase the effective Ag surface. A new type of compensator, to move the liquid as a whole at a low constant rate in order to assign to any boundary any desired apparent velocity, is a modification of the Tiselius construction and gives several advantages. Details of mounting, filling and using the apparatus are given. [See also Abstr. 2383 (1946)]. N. M. B.

541.133.1 : 537.363 : 541.18 : 535.8 2383

Electrophoresis by the moving boundary method. A theoretical and experimental study. III. SVENSSON, H. *Ark. Kemi Min. Geol.*, **22 A** (*No.* 2) *Paper* 10, 156 *pp.* (1946).—[See Abstr. 2382 (1946)]. The method of observation, reported theoretically and descriptively, covers an elementary theory of the crossed-slit method (neglecting the diffraction of light), the light intensity and the factors exerting an influence thereon, and the diffraction. The thickness of the curve is derived, and the resolving power of the method is calculated and discussed. The chief factor influencing the resolving power is the cell thickness. Sources of error analysed include those due to curved and inclined paths of light through the cell and necessitate a mathematical analysis of the light path in a non-homogeneous medium. Errors in the form of wrong shape and wrong position of the peak, and wrong enclosed area are calculated in terms of properties of the gradient and of the apparatus constants. Cells much larger than expected can be used in this method, chiefly because it involves one more parameter than other similar methods: the plane on which the camera objective is focused. Errors due to optical imperfections in the lenses and glass plates are considered, and the requirements to be satisfied by the different components are listed. The optical components are described; a crossed-slit arrangement with concave spherical mirrors instead of lenses has a higher resolving power than the lens system and is completely achromatic, but is inferior to lens arrangements in certain other respects. Directions for adjusting the optical system and methods for experimental determination of apparatus constants are supplied. [See also Abstr. 2384 (1946)]. N. M. B.

541.133.1 : 537.363 : 541.18 2384

Electrophoresis by the moving boundary method. A theoretical and experimental study. IV. SVENSSON, H. *Ark. Kemi Min. Geol.*, **22 A** (*No.* 2) *Paper* 10, 156 *pp.* (1946).—[See Abstr. 2383 (1946)]. "Electrophoretical measurements" covers a description of experiments which verify the predictions of the original theory. It is necessary to measure the charge of the colloid, and this is done by a new method based on combined electrophoresis and conductivity measurements on solutions in Donnan equilibrium; this method in combination with chemical analysis allows the extent to which diffusible ions are bound to the colloids to be determined. Factors influencing the mobility and the isoelectric point of a colloid, the boundary spreading, and the conditions for obtaining correct mobilities are surveyed. Two different methods of measuring mobilities are treated, one with depressed boundary anomalies, where the boundaries diffuse and spread normally, and another with pronounced boundary anomalies where the measurements can be made on very sharp boundaries; the latter method has not yet been applied to colloids. Some mobility studies on serum proteins and haemocyanin are given, and apparently lead to the conclusion that the affinity of proteins for diffusible ions increases with the size of the latter. "Electrophoretical analysis" surveys all sources of error. The applicability of the analyses is tested on a mixture of known composition and on two immune sera, investigated in different buffers. Correct results are obtained in most buffers, but there is doubt about the applicability of heavy ions. Sixty analyses of sera from normal horses, cows, rabbits, pigs, sheep and guinea pigs are presented and show that the individual variations are fairly large, and that the albumin content is lower than many older analyses have shown. Pig serum was subdivided by K phosphate into 6 fractions with increasing solubility, and each fraction and the original serum was analysed electrophoretically. Results check with that of the original serum and this supports the reliability of the method, and shows that the mobility is a fairly stable property. [See also Abstr. 2385 (1946)]. N. M. B.

541.133.1 : 541.18 : 542.8 2385

Electrophoresis by the moving boundary method. A theoretical and experimental study. V. SVENSSON, H. *Ark. Kemi Min. Geol.*, **22 A** (*No.* 2) *Paper* 10, 156 *pp.* (1946).—[See Abstr. 2384 (1946)]. A review of

fractionation and purification by the moving boundary method is given. A continuous-operation apparatus is described; it embodies a new sampling device, the fractions being sucked out through side capillaries on the U-tube walls and fresh material to be purified simultaneously forced in from a bottom capillary. A special commutator device allows the use of small electrodes and electrode tubes, despite an almost unlimited fractionation capacity. N. M. B.

541.134 = 4 2386

Overvoltage in electrolysis. The cases of hydrogen and oxygen. KARPEN, V. *C.R. Acad. Sci., Paris*, **222**, 541–3 (*March* 4); 644–6 (*March* 18, 1946) *In French.*—Overvoltage phenomena have been previously explained on a new theory of contact electromotive forces [Abstr. 1273, 869 (1940), 4384 (1939)], and application of it is now made to hydrogen. A double voltameter is described consisting of two cathodes (platinized Pt on Pt and Au on Au) with a common anode, and immersed in a dilute sulphuric acid solution containing hydrogen under atmospheric pressure. A mode of calculation of hydrogen overvoltage is also given for currents of strength just sufficient to indicate the visible evolution of hydrogen. Experiment and theory are found to be in agreement. For the case of oxygen, the described voltameter contains two anodes of Pt and Au as above with a common cathode in a dilute sulphuric acid bath containing oxygen at atmospheric pressure. A formula is given for the overvoltage, and as the current increases an undervoltage is noted and discussed. H. H. HO.

541.134 2387

The electrical potential at the interface between vitreous silica and solutions of barium chloride. WOOD, L. A., AND ROBINSON, L. B. *J. Chem. Phys.*, **14**, 251–7 (*April*, 1946).—The zeta-potential of vitreous silica in contact with several solutions of $BaCl_2$ has been determined by the measurement of streaming potentials [see Abstr. 1298 (1945)]. Solutions of 7 concentrations between 10^{-6}M and 10^{-2}M, inclusive, were studied, and the zeta-potential was found to decrease in a regular manner with increasing concentration. It is evident that there is no maximum in the curve of the zeta-potential *v.* concentration, as most experimenters have reported.

COLLOIDS . ADSORPTION 541.18

541.18 : 535.8 : 537.363 : 541.133.1 *see Abstr.* 2383

541.18 : 537.363 : 541.133.1 *see Abstr.* 2381, 2382, 2384

541.18 : 542.8 : 541.133.1 *see Abstr.* 2385

541.182.3 : 519.271.0 *see Abstr.* 2225

541.182.4 : 542.952 : 541.124 2388

A general theory of the reaction loci in emulsion polymerization. II. HARKINS, W. D. *J. Chem. Phys.*, **14**, 47–8 (*Jan.*, 1946).—[Abstr. 209 (1946)].

541.183 2389

New evidence for the formation of molecular complexes in monolayers by penetration. JOLY, M. *Nature, Lond.*, **158**, 26–7 (*July* 6, 1946).

541.183 2390

Surface area determination. BUGGE, P. E., KERLOGUE, R. H., AND WESTWICK, F. *Nature, Lond.*, **158**, 28 (*July* 6, 1946).—In the determination of surface area by the method of Brunauer, Emmett and Teller [Abstr. 1479 (1938)] by adsorption of N_2 at liquid nitrogen temperature, it is usual to determine the dead-space on each sample using He. A method is here given for avoiding the dead-space determination, for routine determinations on a substance known to give S-shaped isotherms.

541.183 : 531.19 2391

Statistical mechanics of multimolecular adsorption. I. HILL, T. L. *J. Chem. Phys.*, **14**, 263–7 (*April*, 1946).—Cassie's statistical treatment [Abstr. 3111 (1945)] of multimolecular adsorption on a free surface, leading to the Brunauer–Emmett–Teller equation [Abstr. 1479 (1938)], is criticized and corrected. The method is generalized to include adsorption when the maximum number of layers of adsorbate is restricted. A more refined model is proposed and the general method of using it is discussed. The Brunauer–Emmett–Teller model is shown to be a crude special case of the model suggested here, but it has the advantage of presenting no mathematical difficulties. Preliminary results indicate that the theory is capable of predicting capillary condensation for suitable values of parameters, thus suggesting that the ideas of multimolecular adsorption and capillary condensation are not really in conflict, as is generally assumed.

541.183.26 2392

Theory of multimolecular adsorption from a mixture of gases. HILL, T. L. *J. Chem. Phys.*, **14**, 268–75 (*April*, 1946).—By making use of the evaporation-condensation properties of liquid mixtures, the Brunauer–Emmett–Teller theory of multimolecular adsorption [Abstr. 1479 (1938)] is extended to mixtures of gases.

CHEMICAL STRUCTURE 541.2/.6

541.24 : 539.374 *see Abstr.* 2372

541.57 : 535.342 *see Abstr.* 2302

541.57 : 539.133 *see Abstr.* 2357

541.61 : 531.19 : 536.7 *see Abstr.* 2330

541.64 2393

Division of high polymer physics of the American Physical Society (January 24–6, 1946, meeting). *J. Appl. Phys.*, **17**, 405–7 (*May*, 1946).—Abstracts of 15 papers on different subjects connected with high polymers are given.

541.64 : 536.413 *see Abstr.* 2324

541.64 : 539.217.5 : 533.15 *see Abstr.* 2282

541.67 : 548.7 : 621.315.59 : 537.311.33 *see Abstr.* 2335

541.67 : 621.315.59 : 537.311.33 *see Abstr.* 2336

541.68 : 535.342–15 : 678 2394

Applications of infra-red methods in the structural examination of synthetic rubber. FIELD, J E , WOODFORD, D. E., AND GEHMAN, S. D. *J. Appl. Phys.*, **17**, 386–92 (*May*, 1946).—An important structural detail which can be followed by infra-red analysis is the relative amount of 1,2 and 1,4 polymerization occurring in polymerization reactions of butadiene. Absorption curves are reproduced to show the wide range in the relative amounts of these two structures. A description is given of an attempt to obtain a

quantitative measure of this ratio by means of a calibration curve derived from known mixtures of pure octene 1 and octene 2. For polyisoprene, variations in the proportions of 1,4 and 1,2 or 3,4 structure also occur. Structural differences due to oxidation of polymers may be readily apparent in infra-red spectra, hydroxyl and carbonyl groups being especially prominent. The effectiveness of anti-oxidant in preventing structural changes caused by oxidation is shown in a series of absorption curves for samples of GR-S with and without anti-oxidant.

541.952.6 2395

Thermal polymerization of drying oils. ADAMS, H. E., AND POWERS, P. O. *J. Appl. Phys.*, **17**, 325–37 (*May*, 1946).

CHEMICAL PROCESSES . APPARATUS 542

542.48 2396

Distilling apparatus for production of pure water. HOLMES, F. E. *Industr. Engng Chem.* (*Analyt. Edit.*) **18**, 277 (*April*, 1946).

542.8 : 541.18 : 541.133.1 *see Abstr.* 2385

542.952 : 541.124 : 541.182.4 *see Abstr.* 2388

CHEMICAL ANALYSIS 543/545

543 : 53.088 *see Abstr.* 2248

545.1 : 621.315.221 2397

Analysis of cable sheathing alloys. HAMILTON, G. M. *Nature, Lond.*, **157**, 875 (*June* 29, 1946).—A new method for the analysis of alloys of Pb with up to 2% Sn, 0·8% Sb and 0·25% Cd is outlined. The method is more rapid and convenient than conventional methods.

545.71 : 534.142 *see Abstr.* 2285

545.82 : 535.341 2398

Analyses of mixtures of light gases by infra-red absorption. COGGESHALL, N. D., AND SAIER, E. L. *J. Appl. Phys.*, **17**, 450–6 (*June*, 1946).—A discussion is given of the application of infra-red absorption methods of analysis for light gases which do not obey Beer's law of absorption due to pressure broadening. The method depends upon the nature and intensity of the pressure broadening effect of the different components in the sample upon each other. Data are presented showing the nature of some of these effects and illustrating the accuracy obtainable for certain types of analyses. The instrumentation used in routine gas analyses by infra-red is described.

545.822/.823 : 535.322.1.087.6 *see Abstr.* 2297

545.823 : 669.721.71 2399

An application of multiplier photo-tubes to the spectrochemical analysis of magnesium alloy. NAHSTOLL, G. A., AND BRYAN, F. R. *J. Opt. Soc. Amer.*, **35**, 646–50 (*Oct.*, 1945).

CRYSTALLOGRAPHY 548

548.0 : 539.32 : 553.621 2400

Elastic deficiency and colour of natural smoky quartz. FRONDEL, C. *Phys. Rev.*, **69**, 543–4 (*May* 1 *and* 15, 1946).—Irradiation of quartz with various radiations alters the elastic constants (as indicated by the frequency of piezo-electric oscillations) and gives a smoky colour to the quartz [*Am. Min.*, **30**, 432 (1945)]. Both these effects are restored by baking. It has now been found that natural smoky quartz has a similar elastic deficiency, which can be removed by baking.

548.53 : 553.621 2401

Thermal recrystallization of quartz. D'EUSTACHIO, D., AND GREENWALD, S. *Phys. Rev.*, **69**, 532–3 (*May* 1 *and* 15, 1946).—Thin wafers of quartz (25–30 microns) have been found to be polycrystalline, each crystal being slightly disoriented with respect to its neighbour. Heating at a relatively low temperature (e.g. 100 h at 500°C, 9 h at 800°C) restored them to the appearance of normal, thick, single crystals. The "polycrystalline" state returned after bending 25–50 times to a radius of 1½–2 cm. The degree of recovery suggests that the wafers are not truly polycrystalline, but a series of disoriented regions connected by regions of badly distorted material.

548.7 : 541.67 : 621.315.59 : 537.311.33 *see Abstr.* 2335

548.73 2402

A simple X-ray spectrometer. RIVLIN, R. S., AND ROOKSBY, H. P. *J. Sci. Instrum.*, **23**, 148–50 (*July*, 1946).—A simple X-ray spectrometer suitable for checking the orientation of a face of a crystal is described. The design is based upon a moving-film principle, and the instrument is very simple in construction, being made almost entirely from standard Meccano parts. Although of more limited application than the usual X-ray ionization spectrometer it is well suited to certain routine measurements, particularly in connection with the manufacture of quartz piezo-electric elements.

548.73 : 517.512.2 : 621.3.018.3 : 518.5 *see Abstr.* 2223

548.73 : 537.531 : 535.4 2403

Parafocusing properties of microcrystalline powder layers in X-ray diffraction applied to the design of X-ray goniometers. BRENTANO, J. C. M. *J. Appl. Phys.*, **17**, 420–34 (*June*, 1946).—A distinction is drawn between the focusing properties of single crystals with regard to X-ray diffraction and the parafocusing properties of microcrystalline powder layers. A discussion of these parafocusing properties and of the absorption term, which arises in the diffraction of X-rays from powder layers, is followed by a discussion of various types of powder goniometers. Their characteristic properties are compared. The application of parafocusing conditions to the design of a goniometer for quantitative evaluations and of back-reflection cameras is discussed in greater detail.

548.73 : 621.385.13.032.216 : 537.583 2404

A study of oxide cathodes by X-ray diffraction methods. I. Methods, conversion studies, and thermal expansion coefficients. EISENSTEIN, A. *J. Appl. Phys.*, **17**, 434–43 (*June*, 1946).—Two methods are described for obtaining X-ray diffraction patterns of oxide-coated cathodes. One method is used in the study of the conversion process in forming the oxide cathode

while the other method is utilized in measuring the thermal expansion coefficients of Ba, Sr and Th oxides. The conversion of an equal molar Ba–Sr carbonate solid solution, $(BaSr)CO_3$, involves (1) crystal growth in the carbonate, (2) decomposition to the mixed oxides, BaO and SrO, (3) formation of the oxide solid solution, (BaSr)O, and (4) crystal growth in the oxide. A similar sequence of events is observed in the conversion of a mixed carbonate, $BaCO_3 + SrCO_3$. Crystal and particle size growth of carbonates and crystal growth of oxides are investigated and possible relationships are discussed.

549.211 : 535.372 : 535.343.2 *see Abstr.* 2303

GEOPHYSICS 55

550.345 2405

Seismic sea-wave of November 27, 1945. BEER, A., AND STAGG, J. M. *Nature, Lond.*, **158,** 63 (*July* 13, 1946).

550.385 : 523.75 = 4 *see Abstr.* 2231

551.464 2406

On the salinity of the surface waters of the Irish sea. PROUDMAN, J. *Philos. Trans. A*, **239,** 579–94 (*Jan.* 25, 1946).—A discussion of observations made 1905–1939. The chief variations of the salinity in the central part of the sea during the whole period of observation are recorded. The grand mean values of the characteristics of the salinity and of its seasonal variation are calculated. The degree of correlation is investigated (1) between the salinities at pairs of stations, (2) between the salinities at different stations and the rainfall and barometric gradients. Indications of the mean currents of the sea are obtained from the correlation coefficients. L. S. G.

551.465 : 551.513 2407

Free oscillations of a simple current system. CAHN, A. *J. Met.*, **2,** 113–19 (*June*, 1945).—An incompressible fluid covering a large area of a rotating sphere is considered. In this ocean of fluid a current is imagined to be suddenly produced. The effect of the rotation is to bank the current to the right in the northern hemisphere and this in turn produces oscillations. These are worked out in detail mathematically and it is shown that the disturbance moves off to right and left of its original position with velocity $\sqrt{gD_0}$, D_0 being the depth of the ocean. The waves generated are soon damped out and this may explain why inertial oscillations are difficult to detect in the atmosphere. G. C. McV.

551.482.213 : 621.577 : 536.2 = 3 *see Abstr.* 2319

METEOROLOGY 551.5

551.508.5 2408

Dial wind indicators. IVES, R. L. *Bull. Amer. Met. Soc.*, **27,** 117–20 (*March*, 1946).—The instruments are designed to record wind speed or direction at a predetermined time or interval and to retain the record of conditions for a definite period. They are of the electric-clock-powered, relay-controlled type and rugged and dependable. Details of the construction and wiring diagrams are given. Routine attention is required only at about 30-day intervals. R. S. R.

551.509.312 : 551.511 2409

Movement in meteorology. JAMES, R. W. *Quart. J. R. Met. Soc.*, **71,** 74–87 (*Jan.–April*, 1945).—It is shown that so far as pure advection is concerned, entities like density, density discontinuity (front) and humidity mixing ratio move with the wind at the level considered. Any disparity between actual movement and streamline movement must be put down to development. A pressure-field at a given level is advected in a direction and with a speed given by the average wind at all levels above that level. Similarly the difference in pressure between two fixed levels is advected by the average wind between those levels. Any disparity between actual movement and that determined by the average wind must be attributed to development. Winds are normally available up to pressure levels of 60 mb in the British radiosonde ascents, so that over 90% of the atmopshere can be utilized in computing average winds. Averages based on this data will probably be sufficiently accurate to give a satisfactory measure of advection of tropospheric phenomena. The theory of the pressure-field being advected by the average wind at all levels accounts satisfactorily for the fact that systems with "solid" wind currents do not move. An explanation of "thermal steering" is given. R. S. R.

551.510.534 2410

On a new method of measuring the mean height of the ozone in the atmosphere. WATANABE, K. *J. Franklin Inst.*, **236,** 461–71 (*Nov.*, 1943).—This paper gives results obtained by the use of apparatus devised to measure the thickness and height of the ozone layer [Abstr. 746 (1941)]. Results are only available over a period of 3 months but the advantage of the new method in giving one height measurement per half hour is apparent. Certain errors, already noted, need further investigation to improve results. E. G. M.

551.510.535 2411

On the experimental investigation of night-time *E* ion-densities and their determination by the application of Chapman's formula. SENGUPTA, M. M., AND DUTT, S. K. *Indian J. Phys.*, **18,** 88–96 (*April*, 1944).—It appears that Chapman's formula does not account wholly for the observed night-time *E* ion-density values in different seasons. This is also corroborated by the data obtained at Watheroo which is situated about the same latitude as Patna but in the opposite hemisphere; the ionospheric conditions of these places have been taken to be the same for the purpose of comparison. It is suggested that the value of σ_0 in the Chapman formula, which is taken to be constant throughout for calculations, does not hold good, at least during night-time, and the discrepancy may perhaps be due to this.

551.510.535 2412

Detection of rapidly moving ionospheric clouds. WELLS, H. W., WATTS, J. M., AND GEORGE, D. E. *Phys. Rev.*, **69,** 540–1 (*May* 1 *and* 15, 1946).—Rapidly moving clouds were observed on an automatic 1·5–14 Mc/sec height registering apparatus, and

recorded on photographic film at 30-second intervals. During the magnetic storm of March 25–6, 1946, the clouds moved in from 8–900 km to *F*-layer levels (3–400 km) in a few minutes and sometimes out again at the same rate.

551.511 : 551.509.312 *see Abstr.* 2409

551.513 : 551.465 *see Abstr.* 2407

551.515.1 2413

Meteorology of the Mid-West floods of May, 1943. VEDERMAN, J. *Bull. Amer. Met. Soc.*, **26**, 317–30 (*Oct.*, 1945).—The disastrous floods of May 1943 were due to two storms, May 6–11 and 15–20, 1943. The second storm is described in detail with the help of 23 synoptic charts, both surface and upper air. A table of the forecast and actual rainfall is given which shows the high degree of agreement. G. C. McV.

551.515.8 2414

Winter frontology of China. LU, A. *Bull. Amer. Met. Soc.*, **26**, 309–14 (*Oct.*, 1945).—A description of the motions of the Polar Siberian Air Mass and of the associated phenomena is given. The synoptic situations giving birth to the East China Subarctic Front are also described. G. C. McV.

551.521.63 : 615.831.7 : 535.247.4 2415

Bioclimatic measurements of UV-solar and sky radiation in Washington, D.C., 1941–44. COBLENTZ, W. W. *Bull. Amer. Met. Soc.*, **26**, 113–17 (*April*, 1945).—A new type of photoelectric cell and an electronic integrating device were developed to measure the biologically effective component of u.v.-solar and sky radiation incident on a horizontal plane and an automatic impulse counter and recorder were used. Details of the apparatus and methods used are given. Curves illustrate (1) the diurnal variation in the total radiation of all wavelengths and of the biologically effective u.v. components, and (2) the monthly totals of these two quantities in mW min/cm². [See also Abstr. 1279 (1946)]. R. S. R.

551.543 2416

Contribution to the theory of pressure variations. PETTERSSEN, S. *Quart. J. R. Met. Soc.*, **71**, 56–73 (*Jan.–April*, 1945).—Two separate equations for the barometric tendency at a fixed point, or the height tendency of a pressure surface are derived (*a*) from the hydrostatic equation, and (*b*) from the equations of motion. The hydrostatic tendency equation, which represents a modification of the Margules–Bjerknes equation, relates the barometric tendency (or the height tendency) to the winds integrated through isobaric layers, and also to the patterns of contours and "thicknesses" of the layers. The separate contributions to the pressure variations rendered by the thermal wind, the cyclostrophic components and the horizontal divergence are identified and discussed. Methods of identifying the layer, or layers, that constitute the site of the processes and of assessing the magnitude of their contributions to the pressure variations are outlined. The reaction of the pressure distribution at sea level to the circulation aloft is discussed in some detail, particularly with regard to the travel and development of cyclones, anticyclones, etc. The dynamical tendency equation relates the barometric tendency to the accelerations integrated through isobaric layers. A brief discussion of this equation in relation to typical circulations is given.

551.591.1 : 535.833 *see Abstr.* 2318

551.594.221 : 621.316.98 2417

The frequency of occurrence and the distribution of lightning flashes to transmission lines. GOLDE, R. H. *Trans. Amer. Inst. Elect. Engrs*, **64**, 902–10 (*Suppl. Dec.*, 1945).—[Abstr. 2060 B (1946)].

551.594.25 : 621.319.5 2418

Army-Navy precipitation-static project. VI. High-voltage installation of the precipitation-static project. NEWMAN, M., AND KEMPPAINEN, A. O. *Proc. Inst. Radio Engrs, N.Y. Wav. Electrons*, **34**, 247–55 (*May*, 1946).—[Abstr. 2079 B (1946)].

551.594.25 : 629.135 : 621.396.828 2419

Army-Navy precipitation-static project. IV. Investigations of methods for reducing precipitation-static radio interference. KINZER, G. D., AND MCGEE, J. W. *Proc. Inst. Radio Engrs, N.Y. Wav. Electrons*, **34**, 234–40 (*May*, 1946).—[Abstr. 2165 B (1946)].

551.594.6 : 621.396.11 2420

Radio meteorology; influence of the atmosphere on the propagation of ultra-short radio waves. SHEPPARD, P. A. *Nature, Lond.*, **157**, 860–3 (*June* 29, 1946).—[Abstr. 2140 B (1946)].

553.621 : 539.32 : 548.0 *see Abstr.* 2400

553.621 : 548.53 *see Abstr.* 2401

681.4 2421

A new method of producing aspherical optical surfaces. RINIA, H., AND VAN ALPHEN, P. M. *Proc. K. Ned. Akad. Wet.*, **49** (*No.* 2) 146–9 (1946).—The Schmidt mirror system eliminates spherical aberration by the use of a correction plate. Methods for the cheap mass-production of these correction plates are examined, including the use of moulded plastics. The type of plate finally adopted is of glass coated with a thin layer of gelatin, and details are given of the method of production. Lenses can also be treated in this way and various applications are discussed. A. H.

669.112 : 539.389.3 *see Abstr.* 2373, 2374

669.112 : 539.4.016 : 539.21 *see Abstr.* 2366

669.721.71 : 545.823 *see Abstr.* 2399

678 : 535.342–15 : 541.68 *see Abstr.* 2394

678 : 536.421 *see Abstr.* 2325

678 : 537.221 : 539.42.096 *see Abstr.* 2376

678 : 539.31 *see Abstr.* 2367

678 : 539.373 *see Abstr.* 2371

678 : 539.61 *see Abstr.* 2379

PHOTOGRAPHY 77

770 2422

Photographic progress in 1945. MATTHEWS, G. A. *Photogr. J.*, **86 A**, 77–83 (*April*, 1946).

771.241 : 535.89 = 3 2423

The physics of dark-room lighting for black and white positives. VAN LIEMPT, J. A. M. *Physica, 's Grav.*, **10**, 645–60 (*Oct.*, 1943) *In German.*—A consideration of the conditions to be satisfied by a dark room light, having regard to the different spectral sensitivities of the silver halides, and the Purkinje effect. Curves are given, connecting luminosity with light flux at different wavelengths and illumination levels. Minimum light intensities are prescribed for different wavelengths so that visual inspection of the plate during development shall give a true indication of the contrast when seen under ordinary levels of illumination. N. C.

771.351 : 535.81 2424

A classification of photographic lens types. KINGSLAKE, R. *J. Opt. Soc. Amer.*, **36**, 251–5 (*May*, 1946).

771.36 : 621.383 2425

Electronic shutter-testers. REDEMSKE, R. F. *Electronics*, **19**, 128–34 (*Feb.*, 1946).—[Abstr. 2092 B (1946)].

771.534.544 : 539.215.2 2426

Photographic granularity and graininess. II. The effects of variations in instrumental and analytical techniques. JONES, L. A., AND HIGGINS, G. C. *J. Opt. Soc. Amer.*, **36**, 203–27 (*April*, 1946).—[See Abstr. 154 (1946)]. Proposals for measuring the granularity of developed silver images, in purely objective terms, can be classified into two general groups, namely: those based upon the variations in the transmittance of relatively small elements of the developed image and those which use variations in density. In this paper one method of each of the two classes is examined in some detail. The experimental results indicate clearly that values of granularity, based on the assumption of a Gaussian distribution of transmittance or density values, are not independent of the size of the scanning aperture. Moreover, the frequency of occurrence of transmittance or density variations departs markedly from the Gaussian law when relatively small scanning apertures are used. No scanning aperture size was found which gave granularity v density functions similar in shape to the graininess-density function. Some alternative methods of analysing the basic data are discussed briefly. None of these show promise of yielding a satisfactory solution of this problem. Finally, some semiquantitative data are presented which illustrate the distribution of illuminance on the retinal mosaic when the granular photographic image is viewed at the blending distance. These indicate that the number of visual field elements imaged on a single visual receptor (foveal cone) is small, usually of the order of 3 or 4, and seldom exceeding 8 or 10, even though the photographic materials used in this work varied over a wide range with respect to the coarseness of granular structure.

774/777 242

Photo-engraving in 1945. CARTWRIGHT, H. M. *Photogr. J.*, **86 A**, 100 (*April*, 1946).

778.344 : 535.214–15 = 4 242

New methods for infra-red photography. HEINTZ, E. *C.R. Acad. Sci., Paris*, **222**, 548–50 (*March* 4, 1946). *In French.*—Infra-red radiation falling on the surface of a liquid produces a turbulent motion in the liquid and also a concave deformation of the surface. Details are given showing how these effects may be utilized for the detection of such radiation. In the case of turbulence the motion is shown by means of the addition of aluminium powder. For the second effect it is stated that the magnitude of the deformation (h) is given by $h = k/d^n$ where k is a measure of the flux, d is the thickness of the liquid and n is a positive exponent varying with the nature of the liquid and depending markedly on the viscosity. A. H.

778.344 : 535.33.087.5 : 522.61 2429

The evaporographic method of infra-red photography. SWINGS, P. *Publ. Astr. Soc. Pacif.*, **57**, 16–33 (*Feb.*, 1945).—A history and description of the method for spectrographic work, using a thin membrane coated with an absorbing layer on one side and an evaporating layer (usually oil) on the other. An infra-red spectrum, focused on the absorbing layer, causes local small changes of thickness in the oil layer viewed or photographed through interference effects on a reflected light beam. The method is only in the pioneering stage, but promises useful astronomical applications. D. L. E.

778.37 : 53.087.252 2430

A high power stroboscope. SENIOR, D. A. *J. Sci. Instrum.*, **23**, 81–3 (*April*, 1946).—Gives experimental details and circuit diagram of a unit taking 1 000 photographs per second for a sequence of 1 000 photographs. The duration of each exposure does not exceed 5 μsec. Recording is only suitable for frame-by-frame analysis and the cine film used is run at such a speed as just to separate the photographs. Illumination is by a discharge tube, with series Hg arc rectifier to reduce the de-ionization time. The energy in the flash is 5 joules, obtained by discharge of a condenser, controlled by a commutator. N. C.

778.5 2431

Technical progress in kinematography. CRICKS, R. H. *Photogr. J.*, **86 A**, 96–9 (*April*, 1946).